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ABSTRACT

This volume lists about 2,700 articles, some with annotations, selected from 50 English-language periodicals concerning science, technology, and public policy. Articles included were published between 1946 and 1967. The volume contains the following sections: Information Sources and Services; Philosophy of Science and Technology; Science; Government and Public Policy; Legal Aspects of Science and Technology; Education and Public Understanding of Science; Scientific and Technical Personnel; International Scientific and Technical Cooperation; Organization and Management of Research and Development; Science and Culture: Humanities, Ethics-Revision; and Science and Society. Each section is subdivided so that related papers, or those dealing with a single geographic region are listed together under the principal headings. An introductory note outlines the problems of compilation, the criteria for selection, and the limitations of the bibliography. (AL)

AUG 19 1970

SCIENCE TECHNOLOGY AND PUBLIC POLICY

A SELECTED AND ANNOTATED BIBLIOGRAPHY II

LYNTON K. CALDWELL - EDITOR
ASSISTED BY WILLIAM B. DeVILLE
AND GERTRUDE W. LINDESMITH

Department of Government
INDIANA UNIVERSITY

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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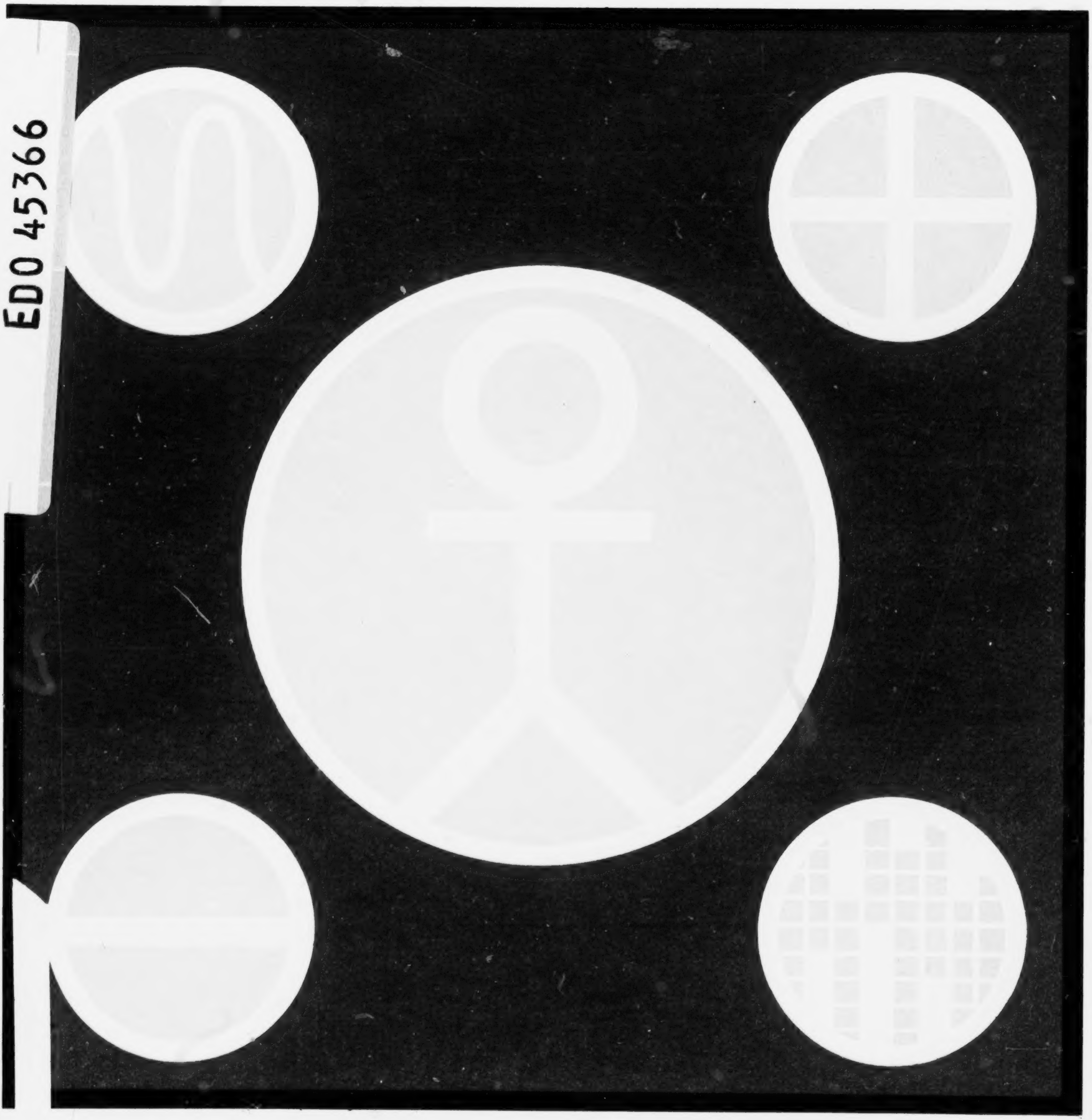

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SCIENCE, TECHNOLOGY, AND PUBLIC POLICY A SELECTED AND ANNOTATED BIBLIOGRAPHY

LYNTON K. CALDWELL
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VOLUME II
Articles in Journals

Prepared for the National Science Foundation
By The
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Department of Government

INDIANA UNIVERSITY

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1969

PREFACE
To Volume II

This volume lists and where necessary annotates some 2,700 articles selected from 50 periodicals.* With some modifications in the sub-divisions of its contents, it continues the survey begun in Volume I of the literature on science, technology, and public policy published in English for the period 1945 through 1967.

As an aid to the users of this volume the editors have undertaken to restate the purposes of the bibliography, to indicate its emphases and its limitations, and to make clear what it does and does not purport to provide.

The bibliography represents an effort to provide, as rapidly and economically as possible, a survey of the more generally accessible literature in this emergent field of study. In attempting this, certain difficulties have been encountered that have influenced the outcome of the effort and of which users of the bibliography should be aware. Principal among these difficulties are: (1) the imprecise boundaries of the field of study; (2) the very large volume of relevant literature; (3) the widely scattered and diverse sources of the literature; (4) the intermixing of substantive or technical subject matter with policy-oriented content, which poses severe problems of selection and classification; (5) the large number of writings pertaining to issues or events of limited timeliness that are not significant in proportion to their volume as contributions to the literature of the field (e.g., United States visa policy for visiting foreign scientists); and (6) a not infrequent occurrence of multiple-publication of articles, sometimes under changed titles, in two or more journals, such as separate publication of the same article in England and in the United States. Before commenting briefly on these difficulties, which are inevitably also difficulties of the field of study, certain general observations about the effort should be made.

It has not been the purpose of the editors to produce a definitive bibliography of the field. To provide a definitive treatment limited to publications in English for the years 1945-67 would increase the size of the bibliography by at least half. The size might easily be doubled if relevant editorials and articles in news magazines and in popular journals were included. More importantly, the search for the less accessible or less apparent writings would require proportionately far more time than the survey of the more readily available sources represented in this work. The editors, supported by the National Science Foundation, have sought to provide a respectable coverage of the literature that would have immediate practical utility. Judged by the response to its publication, Volume I has provided a much-needed aid to a new and rapidly developing field of study. A definitive bibliography in the literature of public policy for science and technology would be an improvement upon what could be made available within the constraints of time and money represented by this present effort. But were such a work to be attempted it would have to cover at least the same preparatory ground as the editors have already covered. Our efforts have been those that would first have to be taken to achieve this more elaborate and more costly goal. We have done what the circumstances seem to require and permit, but would be happy to see others continue the effort toward a more comprehensive work.

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*A list of journals and their abbreviations follows this preface and is repeated on pages 372-374 for the convenience of the reader.

Among specific bibliographical problems the imprecise boundaries of the field of study are most readily apparent. We have thought it best to err, if we must, on the side of breadth rather than in the direction of a more concise delimitation. The needs of users are varied, and for many of them the background data covered by Sections 2 through 4 will be useful. The history and philosophy of science and technology is a field of study distinct and apart from the study of public policy for science and technology. But the two areas of study are nevertheless related in important ways. Most importantly, the history and philosophy of science and technology affords an intellectual foundation for the study of science policy. We have therefore listed in Volumes I and II works in these fields that students of science policy might find useful. These citations are not necessarily those that all students of the history and philosophy of science and technology would select; they are not intended for reference by students in these fields who have recourse to more specialized bibliographical sources.

The large amount of relevant literature has placed a ceiling upon the number of journals that can be surveyed for a bibliography of specified size. The scattered and diverse sources of the literature add to difficulties of quantity. For the user it may be as important to know what the bibliography does not cover as it is to know what it contains. The only reliable way to provide assurance to the reader of what he is being offered seemed to be to limit the coverage to a specified number of journals, to survey them thoroughly, and not to include random articles from other sources unless the entire source could be surveyed for the period covered by the bibliography. This means, of course, that there will be relevant articles of high quality that will not be included in our listing. But the only systematic way to avoid this regrettable inevitability is to survey all periodicals--an impossible undertaking within the limiting circumstances of this work. There have been at least 150 journals in publication during the period covered by this bibliography that could yield articles of significance to the study of public policy for science and technology. In our selection of 50 journals we undertook to include the most abundant sources of relevant articles and also to cover the widest possible range of user interests--from engineering to esthetics.

The intermixing of substantive and technical subject-matter with policy-oriented content in writings related to science policy has created major difficulties of selection in both Volumes I and II. There are many books and articles that have important implications for science policy although they do not deal with policy matters directly. Should they be included? Most of them cannot be, for to include them would be to include a high percentage of all scientific and technical writing. A listing that included them would truly be encyclopedic. But how and where does one draw the line that separates substantive science from science policy? Probably no two editors would agree on all uncertain cases.

A final difficulty of selection pertains to those writings--often polemical--that burgeon around controversial but relatively short-term political issues. If the existing literature were to be listed in direct proportion to its volume, certain topics would heavily outweigh others, not because of intrinsic or long range importance, but because large numbers of people wrote voluminously about the topic at the time. Some of this literature must be included, but how much? Who decides what ultimate importance attaches to a given issue--the nuclear test ban treaty, for example, or international travel by scientists? The editors have tried to give priority to articles of continuing relevance over those largely limited in importance to a given place and time. They have also avoided extensive coverage of topics treated in detail in other bibliographies.

At the risk of redundancy, it may be useful to indicate more explicitly the basis upon which the items comprising Volume II have been selected. Selection has been the major task in the preparation of this volume. The amount of material greatly exceeded the space available. Criteria for selection were necessary. The editors were guided in their choices by a number of criteria that are stated as follows. With certain exceptions in which the great importance of an item overrode all other considerations, selections were made on the basis of the following tests:

(1) No adequate or readily available bibliography already covered the subject-matter.

In the interest of user convenience, important or representative items may be listed even in instances where specialized bibliographies are available. In Volume I, however, reference is made to the more specialized bibliographical sources.

(2) The subject-matter of the item was sufficiently generalized, or sufficiently related to general issues or principles, to be of continuing interest and importance to the greater number of probable users.

Certain issues of relatively limited continuing significance have been omitted or closely restricted. For example, United States visa policy for visiting scientists from abroad was the occasion for several years for numerous articles, editorials, and polemics. Retrospectively, the quantity of published writings on the issue seemed to the editors to be disproportionate to its intrinsic importance. Accordingly, coverage on this subject is representative but by no means all inclusive.

(3) The amount of published material on the subject matter of the article was not so great as to require separate bibliographical treatment in order to provide comprehensive coverage.

Examples of science policy issues with an inordinately large literature are: the nuclear test ban, radioactive fallout, weapons systems policy, disarmament, the human population explosion, environmental pollution and world food production, and the "war on hunger." Many of the leading systematic books in these fields provide extensive reference to the periodical literature. To have listed all relevant articles on these topics in Volume II could have easily overbalanced the listings at the expense of other important items not nearly so well identified in other published sources.

(4) The article was signed or specific authorship was otherwise identified.

Unsigned articles, editorials, letters-to-the-editor, and news notes have rarely been included.

(5) The article is not merely a reprinting of another article already selected.

Where multiple publication or reprinting of an article has occurred, the editors have generally treated either the initial publication, or the one most generally available, as the principal item, have annotated it, and have merely referenced the other printings by journal and date.

Division of the volumes by books and by articles requires a person searching references on a particular subject--e.g. international scientific unions--to consult two or more volumes. But in many libraries periodicals are physically separated from other publications. In the library the user may therefore not be greatly inconvenienced by our separation of books from articles. To obtain an adequate assessment of the scope and coverage of any topic, both Volumes I and II must be consulted. This is especially so because, for many topics, the literature is not divided evenly between books and periodicals. New topics often appear in journals before they appear between the covers of a book.

For the period beginning January, 1968, a bibliographical bulletin issued by the Battelle Memorial Institute in Columbus, Ohio, has provided continuing coverage of the subject-matter encompassed by this bibliography. This new publication fills a need for monitoring the growing literature in this field. Systematic bibliographical surveys are from now on indispensable to the growth and development of the study of the interactions of science, technology, and public policy. It would be desirable for a regular, comprehensive bibliographical service to be undertaken on a continuing professionalized basis and to include publications in languages in addition to those in English. For this service, however, a long-term adequately funded institutional commitment would be required.

	Titles	Abbreviations
1.	Advancement of Science	Adv Sci
2.	American Behavioral Scientist	ABS
3.	American Political Science Review	APSR
4.	American Scientist	Am Sci
5.	American Journal of International Law	AJIL
6.	American Sociological Review	ASR
7.	Annals of Science	Ann Sci
8.	Annals of the American Academy of Political and Social Science	Annals
9.	AIBS Bulletin (BioScience)	AIBS Bulletin (BioSci)
10.	Bulletin of the Atomic Scientists	BAS
11.	Canadian Scientist	Can Sci
12.	Chemical and Engineering News	CEN
13.	Cybernetica	same
14.	Daedalus	same
15.	Educational Record	Ed Rec
16.	Endeavour	same
17.	Environmental Science and Technology	EST
18.	Impact of Science and Technology	Impact
19.	Industrial Research	Ind Res
20.	International Affairs	Int Aff
21.	International Science and Technology	IST (also S & T (IST))
22.	Isis	same

	Titles	Abbreviations
23.	Journal of the American Medical Association	JAMA
24.	Journal of Aesthetics and Art Criticism	JAAC
25.	Journal of the Australian Regional Groups, (etc.)	Pub Ad Aus
26.	Journal of the History of Ideas	JHI
27.	Journal of Social Issues	JSI
28.	Nature	same
29.	New England Journal of Medicine	NEJM
30.	New Scientist	New Sci
31.	Lex et Scientia	Lex et Sci
32.	Main Currents in Modern Thought	MCMT
33.	Minerva	same
34.	OECD Observer	same
35.	Perspectives in Biology and Medicine	PBM
36.	Physics Today	Phys Today
37.	Political Quarterly	Pol Q
38.	Public Administration Review	PAR
39.	Research Management	Res Man
40.	Science	same
41.	Science Journal	Sci Journal
42.	Scientific American	Sci Am
43.	Scientific Monthly	Sci Mon
44.	Scientist and Citizen	Sci Cit

	Titles	Abbreviations
45.	Scientific Research	Sci Res
46.	Social Forces	Soc Forces
47.	Technology and Culture	Tech Cult
48.	UNESCO Courier	Courier
49.	The Yale Review	Yale Rev
50.	Zygon	same

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SECTION I

INFORMATION SOURCES AND SERVICES

The articles cited in this section deal with problems of scientific communication and with systematic efforts to make available scientific and technical information. The articles range in coverage from general discussions of the difficulties of handling the growing volume of literature, to discussions of particular services or facilities for indexing, abstracting, and information gathering, storage, and retrieval. Several articles discuss information service activities of national or international governmental agencies. Other articles relevant to automated information processing systems may be found in section 4.2.

ADAMS, Scott. "The National Library of Medicine's Role in Biomedical Communications," BioSci, XV (September, 1965), 585-588.

ALPERT, Harry. "Science Records: Viewpoints of the Sociology of Science," Isis, LIII (March, 1962), 67-71.

From the sociologist's viewpoint, science archives should include records which can give the historian insight into: (1) attitudes, values and opinions; (2) the decision-making process; and (3) the genesis, organization and development of professional scientific societies.

BIRR, Kendall. " 'What Shall We Save?' An Historian's View," Isis, LIII (March, 1962), 72-79.

Suggests that laboratories--including industrial research laboratories--adopt a detailed archival policy so that administrative and other aspects of organizational history remain accessible to the historian.

BOUTRY, G. A. "Some Aspects of the Problems of Scientific Information," Impact, XII, (No. 3, 1962), 203-210.

Social and technological aspects.

BRADY, Edward L. and Merrill B. WALLENSTEIN. "The National Standard Reference Data System," Science, CLVI (May 12, 1967), 754-762.

A government-wide effort to give to the technical community of the U.S. optimum access to the quantitative data of physical science, critically evaluated and compiled for convenience.

BRODE, Wallace R. "International Exchange of Scientific Information," CEN, XXVIII (December 11, 1950), 4332-4337; 4406.

Government bureaucracies and diplomatic red tape multiply complexities in foreign relations in science.

BROWNSON, Helen L. "Research on Handling Scientific Information," Science, CXXXII (December 30, 1960), 1922-1931.

Indicates present scope and objectives of this research, which should result in improved methods of communication among scientists.

CARTER, Launor F. "National Document-Handling Systems in Science and Technology," Science, CLIV (December 9, 1966), 1299-1304.

The federal government's responsibilities and ways in which they can be met.

Chemical and Engineering News. "Information Systems Grow with New Methods," CEN, XLV (August 28, 1967), 101-104.

Describes how chemical companies, universities, and public libraries step up exchange of computerized information.

CRANE, E. J. "Scientists Share and Serve," CEN, XXIX (October 15, 1951), 4250-4253.

Chemical Abstracts is one of the best mediums of national neighborliness because of its dissemination of chemical progress.

Department of Defense, Special Committee on Technical R & D Information Research and Development Board. "Technical Information Activities of the Department of Defense," Science, CXIV (December 21, 1951), 653-661.

Describes work done by Office of Secretary of Defense and the joint technical activities of the Army, Navy and Air Force, as well as that of the AEC.

DUPREE, A. Hunter. "What Manuscripts the Historian Wants Saved," Isis, LIII (March, 1962), 63-66.

Other than published papers, the historian may be concerned with three categories of materials: personal letters, administrative records, and informal memoranda.

EVANS, Luther H. "The Library of Congress as the National Library of Science," Sci Mon, LXVI (May, 1948), 405-412.

Describes the science collections and services of the Library of Congress.

GARFIELD, Eugene. "'Science Citation Index'--A New Dimension in Indexing," Science, CXLIV (May 8, 1964), 649-654.

Attempts to provide a perspective on the science-information or science "indexing" problem and indicates importance of the Science Citation Index.

GOLDSMITH, H. H. "The Literature of Atomic Energy of the Past Decade," Sci Mon, LXVIII (May, 1949), 291-298.

Publication in the U.S. and other countries, with special attention to problem of secrecy.

GRAY, Dwight E. "Dissemination of Technical Information by AEC," Phys Today, IV (November, 1951), 22-24.

Kinds of information and methods of making them available by the AEC.

________. "Office of Technical Services of the Department of Commerce," Phys Today, IV (December, 1951), 24-26.

The OTS as a scientific and technical information service; advisory service to inventors.

________. "Science, Technology, and the Library of Congress," Phys Today, XVIII (June, 1965), 44-48.

GREEN, John C. "The Information Explosion - Real or Imaginary?" Science, CXLIV (May 8, 1964), 646-648.

Describes emerging design for a national system of handling scientific and technical information, and notes existing services such as abstracting and indexing services, government information services, and specialized centers.

GROVER, Wayne C. "The Role of the Archivist in the Preservation of Scientific Records," Isis, LIII (March, 1962), 55-62.

Discusses three areas--government, academic and industrial--where there is an archival responsibility for the preservation of scientific records.

HOOKWAY, H. T. "The Office for Scientific and Technical Information," Nature, CCVII (July 17, 1965), 234-236.

A new information center in Britain under the Department of Education and Science.

KAREL, Leonard, Charles J. AUSTIN, and Martin M. CUMMINGS. "Computerized Bibliographic Services for Biomedicine," Science, CXLVIII (May 7, 1965), 766-772.

MEDLARS (Medical Literature Analysis and Retrieval System) at the National Library of Medicine is described and the man-machine relationships are discussed.

KNOX, W. T. "The Technical Information Crisis," Res Man, V (May, 1962), 167-176.

Comments on efforts to develop information systems and to study the interaction between the users of information and the information itself.

________. "The Government Makes Plans," Phys Today, XIX (January, 1966), 39-44.

Plans for government involvement in a national scientific information service.

KRIDLER, Thomas and Gustavus SIMPSON. "Should Science Information be Centralized or Decentralized?" ABS, VIII (February, 1965), 29-33.

Compares scientific information services in the U.S. and the U.S.S.R.

LAMB, Arthur B. "Publication--Lifeblood of Science," CEN, XXVII (October 3, 1949), 2841-2844; 2876.

Periodicals are the most important factor in the dissemination of new knowledge.

LEAKE, Chauncey D. "Responsibility for Science Archives," Isis, LIII (March, 1962), 143-148.

The goals and purposes of the organization and administration of archives preserving scientific material.

Minerva. "Science, Government and Information," Minerva, II (Autumn, 1963), 91-117.

Summary of a report of the President's Science Advisory Committee. Discusses the responsibilities of the technical community and the government in the transfer of information.

Organization for Economic Cooperation and Development. "The Flow of Scientific Research Information to Industry," OECD Observer, No. 9 (April, 1964), 12-15.

OECD has undertaken an international program to encourage a network of specialist information centers for science and technology.

O ERHAGE, Carl F. J. "Plans for Project Intrex," Science, CLII (May 20, 1966), 1032-1037.

iscusses the proposal of the Massachusetts Institute of Technology to establish n experimental base for the design of future information services.

———. "Science Libraries: Prospects and Problems," Science, CLV (February 17, 1967), 802-806.

Discusses how new information technology can be effective if scientists give more care to their literature.

PARKINS, Phyllis V. "BioSciences Information Service of Biological Abstracts," Science, CLII (May 13, 1966), 889-894.

PEISS, Reuben. "Acquisition of Foreign Scientific Publications," CEN, XXVIII (April 24, 1950), 1364-1366.

Technical difficulties, paper shortages, and poor cultural relations are some of the difficulties in obtaining certain kinds of publications.

PERRET, Roland P. "A New Form of International Scientific Co-Operation: Common Services," OECD Observer, No. 8 (February, 1964), 14-16.

The European Nuclear Energy Agency has inaugurated a Nuclear Computing Program Library and a Neutron Data Compilation Center as means for improving international information exchange.

REUCK, A.V.S. de. "Learned Societies as Publishers," Nature, CXCVII (February 2, 1963), 426-427.

Reports on a London meeting of the Scientific Publications Council held on December 13, 1962, to discuss "Publication of Journals by Scientific Societies."

RIGGS, F. Behn. "World Information Center," BAS, XXI (January, 1965), 34-35.

Describes the needs fulfilled by the International Physics Activities at the American Institute of Physics, a central clearing house of information on physicists with international interests.

SHERROD, John. "The Library of Congress," Science, CXXVII (April 25, 1958), 958-959.

The science collection and its broad reference service for readers.

SPARKS, W. J. "Information Services and the Continuing Responsibility of the Individual Researcher," Res Man, V (July, 1962), 249-256.

Seven areas covering the relationship between the individual researcher and organized information services.

URQUHART, D. J. "The National Lending Library for Science and Technology," Nature, CXCVI (December 15, 1962), 1034-1036.

Establishment and services of Britain's new central library for science and technology.

VICKERY, B. C. "Scientific Information: Problems and Prospects," Minerva, II (Autumn, 1963), 21-38.

Discusses the purposes of and demands for scientific information, the use of machines for handling the information explosion, and notes that these cannot substitute for the commitment of scientists to the work of collecting, indexing, reviewing and correlating information. (See also VICKERY, B. C. and D. J. SIMPSON, "Future of Scientific Communication," Sci Journal, II, No. 7 (July, 1966), 80-85, for views on the storage, retrieval, and future of scientific communication.)

WEINBERG, Alvin M. "Scientific Communication," IST, No. 16 (April, 1963), 65-74.

The chairman of a special panel to study science, government, and information makes a number of suggestions for the storage and transfer of scientific information.

WOOD, G. Congdon. "Chemical-Biological Documentation: A New Approach," AIBS Bulletin, III (October, 1953), 16-18.

Describes the work of the Chemical-Biological Coordination Center of the National Research Council.

SECTION 2

PHILOSOPHY OF SCIENCE AND TECHNOLOGY

Writings from this field of study are included for the purpose of aiding the student of science policy to examine his subject against a background of at least minimal understanding of the meanings of "science" and "technology," their characteristics, conceptual assumptions, and place in man's intellectual history. This section does not purport to be a general bibliography of the philosophy of science or technology. It is limited to works believed to be most generally useful to persons who are not students of these subjects, but whose ability to understand public policy for science and technology would be enhanced by some familiarity with the theoretical foundations of scientific thought and method and the philosophical implications of technology. Additional and related materials on the sociological aspects of philosophy of science (2.3) may also be found in sections 7.1, 8.5, 11.2, 11.3, 12.1 and 12.2.

2.1 GENERAL

AGASSI, Joseph. "The Confusion between Science and Technology in the Standard Philosophies of Science," Tech Cult, VII (Summer, 1966), 348-366.

Argues for a distinction between technology and applied science on the grounds that science, both pure and applied, needs no corroboration as does technology.

AUGER, Pierre. "Limits to Science," BAS, XXI (November, 1965), 21-22.

"In the further enlargement of human knowledge and skills, there may be certain impossibilities which have nothing to do with technical competence but correspond to fundamental physical barriers."

_______. "The Scientific Attitude: A Possible Misunderstanding," Impact, XI (No. 1, 1961), 45-52.

In modern science the essential phenomena take place at the microscopic level, and direct actions on the human level no longer have their place in the introduction of theories and observations to science.

BECK, Lewis White. "The 'Natural Science Ideal' in the Social Sciences," Sci Mon, LXVIII (June, 1949), 386-394.

Examines observational and experimental techniques and the theoretical structure of the natural and the social sciences.

BENJAMIN, A. Cornelius. "On Defining 'Science'," Sci Mon, LXVIII (March, 1949), 192-198.

The definitions of science as "the method of verified hypotheses."

BORN, Max. "The Concept of Reality in Physics," BAS, XIV (October, 1958), 313-321.

Seeks to show that philosophical dogma has no role in interpreting natural science, nor can such dogmas be culled from physics.

________. "Physics and Metaphysics," Sci Mon, LXXXII (May, 1956), 229-235.

In neither physics nor metaphysics is it possible to see the world as a whole because there are valid and complementary images which do not apply simultaneously.

BRONOWSKI, Jacob. "The Logic of Nature," Pol Q, XXVI (July-September, 1955), 258-266.

Analyzed the present fear and distrust of science as frustration at the failure of the logical, cause-and-effect, classical science.

BUNGE, Mario. "Technology as Applied Science," Tech Cult, VII (Summer, 1966), 329-347.

Discusses aspects of the philosophy of technology.

CALDIN, E. F. "The Values of Science," Endeavour, V (October, 1946), 160-163.

"The relationship between science and the philosophical values of truth, goodness, and beauty."

CAMERON, D. Ewen. "The Current Transition in the Conception of Science," Science, CVII (May 28, 1948), 553-558.

Discusses the biological and social sciences and changes in concepts of the cause and the process of abstraction.

CRISSMAN, Paul. "Causation, Chance, Determinism, and Freedom in Nature," Sci Mon, LXI (December, 1945), 455-464.

Three fundamental types of invariant relations in empirical science are discussed with freedom found only in determinism.

DRUCKER, Peter F. "The Technological Revolution: Notes on the Relationship of Technology, Science, and Culture," Tech Cult, II (Fall, 1961), 342-351.

The achievements of the last two centuries lie in a new attitude toward technology rather than in the progress of science.

ELLEGÅRD, Alvar. "Darwinian Theory and Nineteenth-Century Philosophies of Science," JHI, XVIII (June, 1957), 362-393.

Aspects of 19th century philosophies of science which influenced attitudes towards the Darwinian theory.

FEIBLEMAN, James K. "The Philosophy of Tools," Soc Forces, XLV (March, 1967), 329-337.

________. "Pure Science, Applied Science, Technology, Engineering: An Attempt at Definitions," Tech Cult, II (Fall, 1961), 305-317.

Discusses the relations between theory and practice, the potential applicability of pure science, and the cross-fertilization of applied science.

________. "Technology as Skills," Tech Cult, VII (Summer, 1966), 318-328.

"A philosophy of activity."

FITZGERALD, John J. "Physical Science and the Objectives of the Scientist," Phys Today, V (October, 1952), 17-22.

The structure of physical science in its experimental, theoretical, and critical aspects.

GERARD, Ralph W. "The Scope of Science," Sci Mon, LXIV (June, 1947), 496-512.

The nature, divisions, and scope of science; its general limitations; and mental and social science.

HANSON, Norwood Russell. "Scientists and Logicians: A Confrontation," Science, CXXXVIII (December 21, 1962), 1311-1314.

Argues that scientists often have little formal training in scientific analysis because of the separation between science and the logic of science.

HARING, Douglas G. "Science and Social Phenomena," Am Sci, XXXV (July, 1947), 349-363.

Stresses the problems of the social sciences which are different from those of the physical sciences.

HEISENBERG, Werner. "The Representation of Nature in Contemporary Physics," Daedalus, LXXXVII (Summer, 1958), 95-108.

"Changes in the foundations of modern science are an indication of profound transformations in the fundamentals of our existence, which. . .have their effects on all areas of human experience."

HINSHELWOOD, Cyril. "The Internal and the External Worlds," Nature, CLXXXIV (December 12, 1959), 1834-1838.

The basic importance of philosophy in science and the need for responsible interpretation.

HOLLIDAY, L. "Interaction of Technologies," Nature, CXCVII (January 19, 1963), 222-226.

"Benefits accrue from searching for the fundamental principles in individual technologies and for the relationships between them."

HOUK, William G. "The Accidental Century and Biology," BioSci, XVI (June, 1966), 393-395.

Criticizes the planless development of 20th century biology from the standpoint of John Dewey.

HULL, Clark L. "A Primary Social Science Law," Sci Mon, LXXI (October, 1950), 221-228.

To support the claim that the social sciences are true natural sciences, the author shows the law of stimulus generalization operating through a wide range of phenomena.

KRANZBERG, Melvin. "The Unity of Science - Technology," Am Sci, LV (March, 1967), 48-66.

The history of the association of science and technology and current pressures for an even closer association.

KUHN, Thomas S. "The Function of Measurement in Modern Physical Science," Isis, LII (June, 1961), 161-193.

McLACHLAN, Dan, Jr. "A Guess as to What is Science," Phys Today, XIV (June, 1961), 22-27.

Observations on the nature of science, development of a new science, and relations between sciences.

MARITAIN, Jacques. "Science and Ontology," BAS, V (June-July, 1949), 199-200.

Considers the philosophical and social issues involved.

MUMFORD, Lewis. "Technics and Science," Impact, II (January-March, 1951), 10-11.

Without the introduction of science, technical achievement reaches a stage of perfection beyond which it cannot go.

PERRIN, J. "The Progress of Science," Impact, I (October-December, 1950), 101-103.

Problems with space and time caused by the imperfections of our senses, and how we progress to overcome these obstacles.

PLANCK, Max. "The Meaning and Limits of Exact Science," Science, CX (September 30, 1949), 319-327.

Lack of lasting ideological basis for science has led to search for new religions and prophets or to skepticism.

POLANYI, Michael. "Scientific Outlook: Its Sickness and Care," Science, CXXV (March 15, 1957), 480-484.

Criticizes "scientific outlook" in social sciences as misleading and examines the effect of detachment in the social and biological sciences.

SCATES, Douglas E. "The Parallel Roles of Physical and Social Science," Sci Mon, LXIV (January, 1947), 14-20.

Both physical and social scientists "seek to sift the essential from the non-essential among the conditions which produce certain results".

SCHMIDT, Paul F. "Models of Scientific Thought," Am Sci, XLV (March, 1957), 137-149.

Three models of scientific thought.

SCRIVEN, Michael. "Explanation and Prediction in Evolutionary Theory," Science, CXXIX (August 28, 1959), 477-482.

Scientific explanation is possible even when prediction is precluded, and Darwin's prediction must be amended to state "that if the struggle for existence continues, the forms of life will probably change."

SIMPSON, George Gaylord. "The Problem of Plan and Purpose in Nature," Sci Mon, LXIV (June, 1947), 481-495.

Examines theories of the purpose of nature in terms of the theories of Lamarck and Darwin.

SKOLIMOWSKI, Henryk. "The Structure of Thinking in Technology," Tech Cult, VII (Summer, 1966), 371-383.

Argues for the distinction between science and technology based on the idea of technological progress and the complex structure of technology.

STEVENSON, Earl P. "Creative Technology," Sci Mon, LXXVI (April, 1953), 203-206.

The pooling of new scientific knowledge has allowed for staggering advances in creative technology.

SWANN, W.F.G. "Engineering and Pure Science," Phys Today, IV (June, 1951), 9-17.

Describes the dichotomy between pure science with its refinement and exactness and the empiricism of human experience.

TOULMIN, Stephen E. "Is There a Limit to Scientific Growth?" , Sci Journal, II, No. 8 (August, 1966), 80-85.

An argument against the idea that the present exponential growth of scientific research must slow down.

van den HAAG, Ernest. "Man as an Object of Science ," Science, CXXX (January 30, 1959), 243-252.

Considers the extent to which the social sciences can predict the behavior of man and concludes that moral values cannot be dispensed with.

WEAVER, Warren. "The Imperfections of Science," Am Sci, XLIX (March, 1961), 99-113.

Five imperfections of science and how they lend attraction to its study and how they can help bridge the gap between science and general learning.

WHEELER, John A. "A Septet of Sibyls: Aids in the Search for Truth," Am Sci, XLIV (October, 1956), 360-377.

Focus is the question: "Can a unifying concept from one field be applied in another?"

WORKING, Holbrook. "Research in the Social Sciences," Science, CIV (August 30, 1946), 193-197.

Presents general view of the similarities and differences between research in the natural sciences and in the social sciences.

2.2 SCIENTIFIC METHOD

BEAN, William B. "A Critique of Criticism in Medicine and the Biological Sciences in 1958," PBM, I (Winter, 1958), 224-232.

Suggests a need to revive criticism as a part of the scientific attitude.

BELL, Daniel. "Twelve Modes of Prediction -a Preliminary Sorting of Approaches in the Social Sciences," Daedalus, XCIII (Summer, 1964), 845-880.

BENJAMIN, A. Cornelius. "Science and Its Presuppositions," Sci Mon, LXXIII (September, 1951), 150-153.

Importance of presuppositions in adding breadth to scientific investigation.

BERGMANN, Gustav. "Sense and Nonsense in Operationalism, " Sci Mon, LXXIX (October, 1954), 210-214.

Discusses confusion which has arisen from operationalism's having been mistakenly regarded as a philosophic position.

BRIDGMAN, P.W. "Remarks on the Present State of Operationalism," Sci Mon, LXXIX (October, 1954), 224-226.

Gives historical background of his conception of the operational stand.

FEIBLEMAN, James K. "The Role of Hypotheses in the Scientific Method," *PBM,* II (Spring, 1959), 335-346.

________. "Testing Hypotheses by Experiment," *PBM,* IV (Autumn, 1960), 91-122.

Describes the first step in testing an hypothesis--by experiment to discover factual evidence for or against it.

FIREY, Walter. "Mathematics and Social Theory," *Soc Forces,* XXIX (October, 1950), 20-25.

Mathematics offers a useful and exact language for sociological theory.

HEMPEL, Carl G. "A Logical Appraisal of Operationalism," *Sci Mon,* LXXIX (October, 1954), 215-220.

Analysis of the operationalist view of significant scientific concepts.

INGLE, Dwight J. "Testing Claims to Knowledge in Biology and Medicine," *PBM,* V (Autumn, 1961), 65-85.

Discusses barriers to knowledge, parameters of research, the complexity of causal relationships, and the need for better communication between science and the citizenry.

KAHAN, Théo. "Probability and Modern Life," *Impact,* III (Autumn, 1952), 187-196.

Describes how it is possible to forecast in the very unlikely fields of biology and sociology by using the calculus of probability.

LAZARSFELD, Paul F. "Evidence and Inference in Social Research," *Daedalus,* LXXXVII (Fall, 1958), 99-130.

Problems connected with research in social situations.

LINDSAY, R. B. "Operationalism in Physics Reassessed," *Sci Mon,* LXXIX (October, 1954), 221-223.

Questions the validity of the operational point of view.

LUNDBERG, George A. "Quantitative Methods in Sociology: 1920-1960," *Soc Forces,* XXXIX, (October, 1960), 19-24.

MARGENAU, Henry. "On Interpretations and Misinterpretations of Operationalism," Sci Mon, LXXIX (October, 1954), 209-210.

Attempts "to show that operational definitions occupy a critical role in the methodology of science".

MORRIS, Ian. "Is Science Really 'Scientific'?" , Sci Journal, II, No. 12 (December, 1966), 76-80.

Notes that scientific practice is more complex than "scientific method".

NAGEL, Ernest. "The Methods of Science: What Are They? Can They Be Taught?" Sci Mon, LXX (January, 1950), 19-23.

Scientific method arises out of practice and cannot be taught in the abstract.

NOVAK, Alfred. "Scientific Inquiry," BioSci, XIV (October, 1964), 25-28.

Discusses the nature of scientific inquiry, the approaches to investigation, and the atmosphere necessary for scientific inquiry.

PARKES, A.S. "The Art of Scientific Discovery," PBM, I (Summer, 1958), 366-378.

Discusses creative research in the biological sciences.

ROBINSON, Robert. "Science and the Scientist," Adv Sci, XII (September, 1955), 137-147.

Some of the methods of science and the characteristics of scientists.

RUDNER, Richard. "Remarks on Value Judgements in Scientific Validation," Sci Mon, LXXIX (September, 1954), 151-153.

Science must be precise about value judgements in a given inquiry and about decisions which ought to be made.

RUTSTEIN, David D., Murray EDEN, and Marcel P. SCHUTZENBERGER. "Report on Mathematics in the Medical Sciences," NEJM, CCLXV (July 27, 1961), 172-176.

The interaction of mathematics with the life sciences (see also William G. COCHRAN, The Role of Mathematics in the Medical Sciences, p. 176).

SCHMIDT, Paul F. "Some Merits and Misinterpretations of Scientific Method," Sci Mon, LXXXII (January, 1956), 20-24.

Redefines scientific method in order to show its scope and limitations.

SEEGER, Raymond J. "Beyond Operationalism," Sci Mon, LXXIX (October, 1954), 226-227.

Considers operationalism unproductive and intellectually dissatisfying.

2.3 SOCIOLOGICAL ASPECTS

ACKOFF, Russell L. "Scientific Method and Social Science - East and West," Sci Mon, LXXV (September, 1952), 155-160.

Comparison of Soviet and American social science shows that political influence has fettered and stunted the growth of both.

AUGER, Pierre. "The Quality of Science: Knowledge and Action," Impact, VI (September, 1955), 123-130.

Considers various aspects of the connection between pure and applied science, emphasizing liaison, finances, and secrecy.

BAKER, John R. and A.G. TONSLEY. "The Course of the Controversy on Freedom in Science," Nature, CLVIII (October 26, 1946), 574-576.

The Society for Freedom in Science was founded in Britain in 1940 to oppose the view that scientific research should be directed to economic ends, and directs its attention to investigating issues of freedom vs. organization in science.

BEN-DAVID, Joseph. "Scientific Growth: A Sociological View," Minerva, II (Summer, 1964), 455-476.

Presents views of the social factors influencing the progress of science in Europe.

BERNARD, Jessie. "Can Science Transcend Culture?" Sci Mon, LXXI (October, 1950), 268-273.

The direction of scientific inquiry is culturally determined, but scientific method combats cultural bias.

BLACKMAN, Allan. "Scientism and Planning," ABS, X (September, 1966), 24-28.

How planners can use the method of science rather than just the facts of science to accomplish their goals.

BOXER, L. W. "Interaction of Technologies," Nature, CCVII (September 11, 1965), 1121-1125.

Discusses barriers between science and technology, between various fields of the same, and between scientist and layman.

BURNS, Tom. "The Social Character of Technology," Impact, VII (September, 1956), 147-165.

"The technologist is at the focal point of technical innovation, but he belongs to a separate system which is independent of both science and industry."

CALDIN, E. F. "Science in Society: The Fundamentals," Endeavour, V (April, 1946), 70-73.

Distinguishes pure science as the search for understanding of nature and applied science as the manipulation of nature.

DEDIJER, Stevan. "The Science of Science: A Programme and a Plea," Minerva, IV (Summer, 1966), 489-504.

The science of science -- its tasks, organization of research, and practical benefits.

DEUTSCH, Martin. "Evidence and Inference in Nuclear Research," Daedalus, LXXXVII (Fall, 1958), 88-98.

Discusses the extent to which the attitude of the experimenter and his mental image of the phenomena he studies affect the outcome of his experiment.

DOOLEY, D. J. "Science as Cliché, Fable, and Faith," BAS, XV (November, 1959), 372-375.

"An endeavor to clear away some of the stereotypes which stand in the way of harmony among various intellectual disciplines."

DUPREE, A. Hunter. "Influence of the Past: An Interpretation of Recent Development in the Context of 200 Years of History," Annals, CCCXXVII (January, 1960), 19-26.

Describes the background of the present problems of nationalism vs. internationalism in science, basic vs. applied research, and specialization vs. coordination.

GLOCK, Charles Y. "Some Implications of Organization for Social Research," Soc Forces, XXX (December, 1951), 129-134.

Aspects of the institutional framework in which social science research operates.

GOLDSMITH, Maurice. "The Autonomy of Science: Some Thoughts for Discussion," Pol Q, XXXVIII (January-March, 1967), 81-89.

Contemporary science as a method, an institution, a factor in economic development, and a cultural influence.

________. "Towards a Science of Science," (Interview with J. D. BERNAL). Sci Journal, I, No. 1 (March, 1965), 88-92.

The study of the organization, objectives, and development of science would include the economics of science, scientific manpower, the management of research, and national science policies.

HIRSCH, Walter. "The Autonomy of Science in Totalitarian Societies," Soc Forces, XL (October, 1961), 15-22.

An analysis of the relations between sociopolitical ideology, needs for scientific development, and independence of science in Nazi Germany and the Soviet Union."

HOPPER, Rex D. "Sociological Research in a Time of Crisis," Soc Forces, XXVI (October, 1947), 13-18.

Evaluates the theoretical and methodological adequacy of sociology as a scientific descipline to meet social problems posed by atomic energy and other technological advances.

IHDE, Aaron J. "The Inevitability of Scientific Discovery," Sci Mon, LXVII (December, 1948), 427-429.

Necessity and genius are not the primary factors in discovery; the pressures of accumulating knowledge make discovery inevitable.

LINDSAY, R. Bruce. "Arbitrariness in Physics," Phys Today, XX (December, 1967), 23-26.

Describes physics as invention, rather than discovery, and as open-ended and without ultimate truth.

MEADOWS, Paul. "Science as Experience: A Genetic and Comparative Review," ASR, XIV (October, 1949), 592-599.

Describes science as a social experience with four facets: culture, history, methodology, and rationale.

OSSOWSKA, Maria and Stanislaw OSSOWSKI. "The Science of Science," Minerva, III (Autumn, 1964), 72-82.

Republication of an article which appeared in the Polish journal ORGANON in 1936, setting up a scheme for the systematic study of philosophical, psychological, sociological, administrative, and historical aspects of science.

POLANYI, Michael. "The Autonomy of Science," Sci Mon, LX (February, 1945), 141-150.

Shows that science cannot flourish when it is directed by the state or any outside authority, the corruption of genetic science in the U.S.S.R. being the most striking example. (For the opposite point of view and a discussion of the progress of Soviet genetics under government control, see KARTMAN, Lee, "Soviet Genetics and the 'Autonomy of Science',", ibid., LXI (July, 1945, 67-70.)

_______. "The Growth of Science in Society," Minerva, V (Summer, 1967), 533-545.

Scientific growth is based on the granting of independence to the individual scientist and the assessment of his contributions.

PRESTON, F. W. "Freedom of Research," Sci Mon, LXI (December, 1945), 477-482.

Advocates freedom and sharing of research.

PRICE, Derek J. DeSolla. "The Science of Science," BAS, XXI (October, 1965), 2-8.

Seeks a criterion for judging science, a theory for the science of science.

SAYRE, Anne. "The Scientific Method in Human Affairs," BAS, XI (October, 1955), 295-296.

Discusses the dangers of misplaced emphasis on scientific method.

SMYTH, Henry DeWolf. "From X-Rays to Nuclear Fission," Am Sci, XXXV (October, 1947), 485-501.

Contrasts the success of the application of scientific method in physics with its inapplicability to social and political problems.

________. "The Place of Science in a Free Society," Am Sci, XXXVIII (July, 1950), 426-436.

Historical cases are offered in evidence for the argument that only in a climate of freedom can science progress rapidly.

STEWART, Bruce. "Challenge to Social Science," Science, CX (August 19, 1949), 179-183.

Discusses effects of the industrial revolution and the accompanying "cultural lag."

STRAUSS, Maurice B. "The Climate for the Cultivation of Clinical Research," NEJM, CCLXII (April 21, 1960), 805-810.

Discusses the importance of clinical research in medicine as a study of the whole man rather than just the parts.

THOMSON, David. "Scientific Thought and Revolutionary Movements," Impact, VI (March, 1955), 3-29.

Highlights crucial points at which relationships between revolutionary movements and scientific ideas can be demonstrated.

THOMSON, George. "The Two Aspects of Science," Adv Sci, XVII (September, 1960), 191-196.

Discusses science as man's attempt to understand nature as well as to control it.

WEAVER, Warren. "The Encouragement of Science," Sci Am, CXCIX (September, 1958), 170-178.

Science needs not only adequate financial backing to flourish, but also an educated society and freedom for the satisfaction of curiosity.

WEAVER, Warren. "Why is Science Important?" CEN, XXXIX (February 13, 1961), 144-148.

Science is a source of basic knowledge, is related to technology, is vital to national defense, and contributes to the development of the reasoning mind.

WOLFF, Harold. "The Impact of Society on Science," ABS, X (May, 1967), 2-7.

Criticizes social scientists for avoiding critical issues, for oversimplification, and for their failure to investigate such important social phenomena as the space research effort.

ZILSEL, Edgar. "The Genesis of the Concept of Scientific Progress," JHI, VI (June, 1945), 325-349.

The view that science is the product of cooperation for non-personal ends is a specific characteristic of the scientific spirit and of modern Western civilization.

ZVORIKINE, A. "Technology and the Laws of Its Development," Tech Cult, III (Fall, 1962), 443-458.

A Soviet view of technology as the means of work within a system of social production and social life.

SECTION 3

HISTORY OF SCIENCE AND TECHNOLOGY

As with the preceding section, the published work listed here is cited by way of background for the study of public policy. The idea of a sequence of developments in time is essential to an understanding of the growth of science and technology and their impacts on society and government. Public policy that is not understood in its historical dimensions is not understood adequately. For related materials see section 5, which lists numerous articles describing the history of government-science relations in specific countries, and section 9, in which international cooperative programs and programs of international organizations are cited. A more comprehensive and continuing bibliography is printed annually in Isis, the journal of the History of Science Society.

3.1 HISTORY OF SCIENCE

ALBRECHT-CARRIE, Rene. "Of Science, Its History, and the Teaching Thereof," Sci Mon, LXXIII (July, 1951), 16-24.

Proposes that the study of the history of science be the integrating factor between science and the humanities.

BAY, J. Christian. "Some Vital Books in Science: 1848-1947," Science, CVII (May 14, 1948), 485-491.

Works resulting from U. S. expeditions, and European and American works on chemistry; physics; natural history; biology; mathematics; astronomy; and the history of science.

BEDINI, Silvio A. "The Evolution of Science Museums," Tech Cult, VI (Winter, 1965), 1-29.

The development of science museums and of museum science through five centuries.

BEN-DAVID, Joseph. "The Scientific Role: The Conditions of Its Establishment in Europe," Minerva, IV (Autumn, 1965), 15-54.

The development of science as an autonomous facet of culture in Europe through the medieval and early modern eras and the social factors which contributed to it.

CONANT, James Bryant. "Scientists, Inventors, and Executives," CEN, XXIX (June 4, 1951), 2262-2264.

An historical sketch from the 1780's to the 1950's which explores the importance of the advance of science and its relation to government and industry.

CROMBIE, Alastair Cameron. "Historians and the Scientific Revolution," Endeavour, XIX (January, 1960), 9-13.

________. "Some Reflections on the History of Science and Its Conception of Nature," Ann Sci, VI (October 15, 1948), 54-75.

Deals with European history of science from ancient times to the present and how science dealt with questions about nature.

DINGLE, Herbert. "History of Science and the Sociology of Science," Sci Mon, LXXXII (March, 1956), 107-111.

In order to view it objectively, the history of science must be separated from the social conditions which accompanied it.

DIRAC, P.A.M. "The Evolution of the Physicist's Picture of Nature," Sci Am, CCVIII (May, 1963), 45-53.

The past development of physical theory and its anticipated future development.

FERGUSON, Allan, "Dramatic Moments in the History of Science in Britain," Endeavour, IV (January, 1945), 17-21.

Relates several episodes, such as the confrontation between Thomas H. HUXLEY and Bishop WILBERFORCE, on the subject of evolution.

FOOTE, George A. "The Place of Science in the British Reform Movement, 1830-1850," Isis, XLII (October, 1951), 192-208.

Efforts within and outside government to reform and reorganize British science.

GATES, Warren E. "The Spread of Ibn Khaldûn's Ideas on Climate and Culture," JHI, XXVIII (July-September, 1967), 415-422.

This 14th century writer may be a genuine precursor of Montesquieu with regard to the theory of climatic influence on human groups.

GRANT, Edward. "Hypotheses in Late Medieval and Early Modern Science," Daedalus, XCI (Summer, 1962), 599-612.

(See comments by Benjamin NELSON pp. 612-616.)

GUERLAC, Henry. "Some Aspects of Science During the French Revolution," Sci Mon, LXXX (February, 1955), 93-101.

Because the period of the greatest French scientific leadership coincided with the Revolution, considers the impact of the resultant social changes on the work and thought of the scientists.

HAYNES, Williams. "Out of Alchemy into Chemistry," Sci Mon, LXXV (November, 1952), 268-272.

History of chemistry, from its origins in alchemy to its early days as a "pure science," to its present function in improving the lot of mankind.

JONES, R. V. "Evolution of the Laboratory," Sci Journal, III, No. 1(January, 1967), 81-85.

Scientists have become "soft" under the relatively lavish conditions in the modern laboratory, but it is not clear whether this helps or hurts science.

KUHN, Thomas S. "Historical Structure of Scientific Discovery," Science, CXXXVI (June 1, 1962), 760-764.

Historians can seldom pinpoint the exact time and place of a scientific discovery, and because discoveries demand readjustment, the process of discovery shows structure and extends in time.

McKIE, Douglas. "The Early Years of the Académie des Sciences," Endeavour, XXV (May, 1966), 100-103.

Activities and publications of the French national scientific academy from 1666-1793.

SMITH, Cyril Stanley. "Materials on the Development of Civilization and Science," Science, CXLVIII (May 14, 1965), 908-917.

TEMKIN, Owsei. "Scientific Medicine and Historical Research," PBM, III (Autumn, 1959), 70-85.

"Modern scientific research implies a certain form of historical research as well," that is, the need to prove the novelty of a discovery.

WEISINGER, Herbert. "English Treatment of the Relationship between the Rise of Science and the Renaissance, 1740-1840," Ann Sci, VII (September 28, 1951), 248-274.

The views of later writers on the rise of science and its effects during the Renaissance.

3.2 HISTORY OF TECHNOLOGY

ARMILLAS, Pedro. "Hydraulic Civilizations," Courier, XVII (July-August, 1964), 60-62.

The technology of some early civilizations affected their social and political development through the building of reservoirs, canals, and dikes.

BERNAL, J. D. and D. K. Butt. "The Technical and Social Consequences of the Discovery of Artificial Radioactivity in 1934," Impact, XIV (No. 2, 1964), 89-100.

Practical applications of radioactivity stemming from the Joliot-Curie discovery.

BUCHANAN, Scott. "Technology as a System of Exploitation," Tech Cult, III (Fall, 1962), 535-543.

The ancient association of technology with the arts, its culminations in present-day automation, and the need to restore the human factors to the technological system.

CLOW, Archibald. "Fiscal Policy and the Development of Technology," Ann Sci, X (December, 1954), 342-328.

Gives examples of the effects of taxes and duties on industrial technology in the British Isles from about 1750 to 1850.

CLOW, Archibald and Nan L. CLOW. "The Timber Famine and the Development of Technology," Ann Sci, XII (June, 1956), 85-102.

How the shortage of timber in the British Isles, along with the demands from growing industries, led to new technologies such as the use of coal in the 16th century and afterwards. (See also the refutation of this thesis by FLINN, Michael W., "Timber and the Advance of Technology: A Reconsideration," ibid., June, 1959, 109-120.)

DORNBERGER, Walter R. "The German V-2," Tech Cult, IV (Fall, 1963), 393-409.

"How the Germans came to build it [rocket missile], what inspired them, how they succeeded, and especially why this weapon ... failed to become what its creators intended."

DRUCKER, Peter F. "Work and Tools," Tech Cult, I (Winter, 1959), 28-37.

Urges the study of work, as well as of tools, processes, and products,to make the history of technology really useful.

DRYDEN, Hugh L. "Supersonic Travel within the Last Two Hundred Years," Sci Mon, LXXVIII (May, 1954), 289-295.

Reviews research and observations of the supersonic movements of terrestial objects.

FERGUSON, Eugene S. "Technical Museums and International Exhibitions," Tech Cult, VI (Winter, 1965), 30-46.

The international exhibitions of the 19th century inspired the founding of technical museums, but emphasized the superficial and spectacular aspects of technology.

FINCH, James Kip. "Engineering and Science: A Historical Review and Appraisal," Tech Cult, II (Fall, 1961), 318-332.

The historically independent developments of science and of technology and the importance of their intelligent applications to bring about economic and material progress today.

GILLISPIE, Charles C. "The Natural History of Industry," Isis, XLVIII (December, 1957), 398-407.

Discussion of some historical relations between science and industry.

HALL, A. Rupert. "The Changing Technical Act," Tech Cult, III (Fall, 1962), 501-515.

Technology in history and the factors which influenced modern technological growth, such as the application of science to industry. (See also idem., "Historical Relations of Science and Technology," Nature, CC (December 21, 1963), 1141-1145.)

HEISENBERG, Werner. "Research in Germany and the Technical Application of Atomic Energy," CEN, XXV (September 15, 1947), 2620-2623.

A German atomic bomb project was psychologically and physically impossible because research was directed toward development of a prime mover rather than toward an explosive use.

KENYON, Richard L. "The German Chemical Industry, Past and Present," CEN, XXV (May 19, 1947), 1437-1439.

From an unrivaled position in dyestuffs and pharmaceuticals, W. W. I aided in turning German technical and scientific prowess into channels of hate and destruction.

KINZEL, Augustus B. "Engineering, Civilization, and Society," Science, CLVI (June 9 1967), 1343-1345.

Role played by engineering in man's civilization and society from the ancient world to the present.

LANGEVIN, Luce. "The Introduction of the Metric System: The First Example of Scientific Rationalization by Society," Impact, XI (No. 2, 1961), 77-95.

Account of the beginnings and establishment of the metric system, stressing the interactions of science, technology and social conditions.

McKIE, Douglas. "The Origins of the Metric System," Endeavour, XXII (January, 1963), 24-26.

The introduction of the metric system in France after the Revolution.

MULTHAUF, Robert P. "The Scientist and the 'Improver' of Technology," Tech Cult, I (Winter, 1959), 38-47.

Survey of the relationships between scientists and technologists and their place in society.

MUMFORD, Lewis. "History: Neglected Clue to Technological Change," Tech Cult, II (Summer, 1961), 230-236.

Presents the necessity for viewing the history of technology against the background of cultural history.

PRICE, Derek J. DeSolla. "Is Technology Historically Independent of Science? A Study in Statistical Historiography," Tech Cult, VI (Fall, 1965), 553-568.

Introduces new models based on the literature (science) and the state of the art (technology) to analyze the relations between them.

RONCHI, Vasco. "The Development of Optics and Its Impact on Society," Impact, IX No. 3 (1959), 123-136.

Few aspects of present day life are not beholden to the pioneers who discovered the nature, preservation, and augmentation of sight.

SCHOFIELD, Robert E. "The Industrial Orientation of Science in the Lunar Society of Birmingham," Isis, XLVIII (December, 1957), 408-415.

Early attempt to apply science to problems of industry and society. (For another description of the Lunar Society, see ROBINSON, Eric, "The Philosophers Who Met at the Full Moon," New Sci, XVIII (April 18, 1963), 158-160.)

USHER, Abbott Payson. "The Industrialization of Modern Britain," Tech Cult, II (Spring, 1960), 109-127.

The evolution of industrialization over nearly five centuries.

3.3 HISTORY OF SCIENCE AND TECHNOLOGY IN THE UNITED STATES

ANDERSON, C. Arnold. "The Striving for Cooperative Autonomy: American Social Sciences Over Fifty Years," Soc Forces, XXIX (October, 1950), 8-19.

Changing interrelations among the social sciences during half a century.

BEIDLEMAN, Richard G. "Biology and the North American Wilderness," BioSci, XIV (December, 1964), 22-27.

Notes on the history of biology in America.

BELL, Whitfield J., Jr. "Medicine: Foster Mother of the Sciences," JAMA, CXCVI (April 4, 1966), 50-54.

Many of the 19th century U. S. scientists were trained as physicians.

BURKE, John G. "Bursting Boilers and the Federal Power," *Tech Cult*, VII (Winter, 1966), 1-23.

History of federal regulation, beginning with the problem of bursting steamboat boilers in the early 19th century.

COHEN, I. Bernard. "The Development of Aeronautics in America: A Review of Recent Publications," *Isis*, XXXVII (May, 1947), 58-64.

COMPTON, Arthur H. "The Atomic Crusade and Its Social Implications," *Annals*, CCXLIX (January, 1947), 9-19.

The sequence of events that led to the wartime atomic program, reasons for its success in the U.S., and future implications of its form of organization.

DENNY, Margaret. "The Royal Society and American Scholars," *Sci Mon*, LXV (November, 1947), 415-427.

The influence of the Royal Society of London on colonial and post-revolutionary Americans.

FAIR, Gordon M. "Engineers and Engineering in the Massachusetts State Board of Health," *NEJM*, CCXXXII (April 19, 1945), 443-446.

An historical survey.

FULTON, John F. "The Impact of Science on American History," *Isis*, XLII (October, 1951), 176-191.

Case studies of the impact of science, primarily from medicine, since the 18th century.

GREENE, John C. "Science and the Public in the Age of Jefferson," *Isis*, XLIX (March, 1958), 13-25.

Scientists of Jefferson's day "found their countrymen all too little interested in science. . .and labored as best they could to cultivate a taste for it among the educated classes. . . ."

________. "Some Aspects of American Astronomy, 1750-1815," *Isis*, XLV (December, 1954), 339-358.

Main directions of observation and inquiry, and the connection of these researches with conceptions of nature.

HAGEN, John P. "The Viking and the Vanguard," Tech Cult, IV (Fall, 1963), 435-451.

Discusses the first U.S. earth satellite program and its achievements.

HENDRICKSON, Walter B. "Nineteenth-Century State Geological Surveys: Early Government Support of Science," Isis, LII (September, 1961), 357-371.

Emphasizes the climate of opinion about the justification of public support for the surveys.

HINDLE, Brooke. "The Quaker Background and Science in Colonial Philadelphia," Isis, XLVI (September, 1955), 243-250.

The reasons for the beneficial Quaker influence on the development of science.

KETTERING, Charles F. "Research Opens the Door," Sci Am, CLXXII (January, 1945), 7-12.

Discusses the changing pattern of U.S. research and invention since 1845.

KILGOUR, Frederick G. "How Good Are Our Science and Engineering?," Yale Rev, XLIV (June, 1955), 555-563.

The historical record of U.S. science and engineering has been second-rate compared to Europe. Warns that Russia might assume world leadership.

MILES, Wyndham D. "Chemist Fires on Sumter," CEN, XXXIX (April 3, 1961), 108-115. (Part 1.)

Discusses how the Civil War was influenced by chemists and chemistry. (Part 2. idem., "The Civil War," CEN, XXXIX (April 10, 1961), 116-123 for a continuation of the discussion.)

________. "The Polaris," Tech Cult, IV (Fall, 1963), 478-489.

History of the Navy's missile program.

MULTHAUF, Robert P. "A Museum Case History: The Department of Science and Technology of the United States Museum of History and Technology," Tech Cult, VI (Winter, 1965), 47-58.

History, present organization of the museum, and its exhibits.

NASH, Gerald D. "The Conflict Between Pure and Applied Science in Nineteenth-Century Public Policy: The California State Geological Survey, 1860-1874," Isis, LIV (June, 1963), 217-228.

A study of the aims and practices of governmental funding for the survey.

OLIVER, John S. "A Significant Decade in Science," Sci Mon, LXVII (August, 1948), 83-86.

Review of events from 1840-1848, when the American Association for the Advancement of Science was founded.

PENDRAY, G. Edward. "Pioneer Rocket Development in the United States," Tech Cult, IV (Fall, 1963), 384-392.

Describes experimentation with rockets before W.W.II.

PERRY, Robert L. "The Atlas, Thor, and Titan," Tech Cult, IV (Fall, 1963), 466-477.

The U.S. Air Force ballistic missile effort and its applications to space technology.

RAE, John B. "The 'Know-How' Tradition: Technology in American History," Tech Cult, II (Spring, 1960), 139-150.

Examples of the place of technology in American life, the pragmatic approach, the relationship between technological development and industrial application, and the role of technology in industrial organization.

REINGOLD, Nathan. "The National Archives and the History of Science in America," Isis, LXVI (March, 1953), 22-28.

History and description of the National Archives, with suggestions for use by historians of science.

________. "Science in the Civil War," Isis, XLIV (September, 1958), 307-318.

An explanation of why two federal organizations, created early in 1863 to provide scientific advice and aid, accomplished so little of either during the Civil War.

STRUIK, D. J. "American Science Between 1780 and 1930," Science, CXXIX (April 24, 1959), 1100-1106.

How the exploration and industrialization of the new nation led to advances in natural science and technology.

TELLER, Edward. "The Work of Many People," Science, CXXI (February 25, 1955), 267-275.

Describes the conception, theory, and calculations in the development of the hydrogen bomb.

THOMSON, George. "Anglo-U.S. Cooperation on Atomic Energy," Am Sci, XLI (January, 1953), 75-80.

Story of the exchange of information between British and American scientists which led to the Manhattan project and the development of the atomic bomb.

TURRER, Joseph. "First Scientific Bureau," Science, CXXV (February 8, 1957), 217.

Establishment of the United States Coast and Geodetic Survey on February 10, 1807.

Von BRAUN, Wernher. "The Redstone, Jupiter, and Juno," Tech Cult, IV (Fall, 1963), 452-465.

Contributions of the first U.S. missile systems to weapons development, space technology, and knowledge of the universe.

ZIRKLE, Conway. "Benjamin Franklin, Thomas Malthus and the United States Census," Isis, XLVIII (March, 1957), 58-62.

Franklin's writing on population growth, which was cited by Malthus, contained remarkably accurate forecasts of U.S. population.

SECTION 4

NATURE AND IMPACT OF SCIENCE AND TECHNOLOGY

The material cited here deals primarily with the social developments and public policy issues growing out of the application of science to human affairs. The organization of materials follows lines of contemporary research, in so far as they were represented in the journals surveyed. It does not represent the editors' arbitrary assignment of value to one field over another. Some of the more significant data on the impact of technology are obtainable only by implication in works on engineering, medicine, and public health which could not be included within the space limitations prescribed for this bibliography.

Section 4.2 includes items concerning computers, information theory, manpower aspects of automation, and human engineering.

Section 4.3 cites articles dealing with the conditions surrounding scientific discoveries and their implementation, and methods for predicting future states of science and technology with some degree of reliability.

Section 4.4 includes articles dealing with those technologies which tend to shrink "human space," i.e., communication and transportation. Several articles explore such policy implications of proposed supersonic aircraft as questions of social and economic need, developmental requirements, and potential environmental hazards which might result from their use.

Section 4.5 cites articles dealing with the impacts upon society of space exploration, including assessments of the so-called scientific and technological "spin-off" of space programs. Additional and related materials are cited in sections 5.2.1.4.8, 5.2.2.1, 5.2.6.3, 6.2.3, 9.3.2, and 9.3.4.

Section 4.6 contains citations of articles dealing with the nature and impact of various energy technologies in general, and of nuclear energy in particular. The large volume of literature on nuclear energy to be found in the selected journals covered in this bibliography, especially in the *Bulletin of the Atomic Scientists*, has made it unfeasable to list more than a small percentage of the published articles. Most of those included are concerned with peaceful uses of nuclear energy. The reader is directed to the *BAS* for coverage of such issues as the question of civilian versus military control of nuclear energy in the United States, the nuclear test ban treaty discussions, and the controversial questions of civil defense preparations for nuclear war. Scientist and Citizen (Environment, after January 1, 1969) is also recommended for further information in the above areas. Additional and related materials may be found in section 5, and particularly in 5.2.1.4.1, 5.2.2.5, and 5.2.6.3. Legal aspects of nuclear energy are cited in section 6.2.4, and European cooperative efforts in nuclear energy development are cited in section 9.3.2.

Many of the articles cited in section 4.7 are concerned with two major aspects of man's uses of science and technology in relation to his environment: uses of science and technology to increase or stretch food and other resources; and relatively new perspectives of the impact of the use of technology on the environment, particularly in view of the rapidly increasing stresses upon the environment resulting from the population and technology explosions. Additional and related materials will be found in section 6.2, which explores some of the legal problems of international rivalry or cooperation in the use of resources; and in section 6.6, which deals more specifically with legal aspects of environmental control. Articles dealing with suggested benefits and problems of technological development will be found in section 5.2.10. Related items will be found under section 9, dealing with international scientific and technological cooperation. Articles dealing with general perspectives on the uses of science and technology for human purposes will be found in section 12.1.

Section 4.8 cites articles dealing with the development of biomedical sciences and technologies, their relevance to other scientific disciplines, and their impact on society. Additional and related articles will be found under national headings in section 5, e.g., 5.2.1.4.2, where governmental policy or the role of governmental agencies has been prominent. Legal aspects of biomedical sciences have been dealt with in sections 6.3 and 6.4, and some of the ethical problems of biomedical experimentations are discussed in section 11.2. International cooperative programs concerned with biomedical sciences will be found in section 9. Some additional items are included under section 10.

In section 4.9, the impacts of developments in psychology, biological sciences, information theory, and automation on educational philosophies and practices are discussed. Additional and related materials will be found in sections 4.2, 7.1, 8.2, and 8.4.

AUGER, Pierre. "Scientific Progress in the Present-Day World," Impact, I (October-December, 1950), 108-110.

Believes that, beginning in the 18th century, man embarked on the "Scientific Age," and describes the significance of science in life today.

BLUMSTEIN, Alfred. "Police Technology," S+T (IST), LXXII (December, 1967), 42-50.

The need for adapting technological innovations to law enforcement operations.

CONANT, James Bryant. "The Impact of Science on Industry and Medicine," Am Sci, XXXIX (January, 1951), 33-49.

Considers "the organization and financing of pure and applied research in a free society, and the implications of such arrangements for industry and medicine."

COTTRELL, W. Fred. "Death by Dieselization: A Case Study in the Reaction to Technological Change," ASR, XVI (June, 1951), 358-365.

Effects of technological change on society and the costs to be paid.

DRUCKER, Peter F. "The First Technological Revolution and Its Lessons," Tech Cult, VII (Spring, 1966), 143-151.

A study of the great irrigation civilizations of ancient Egypt and Asia indicates that technological revolutions create a need for social and political innovations.

________. "New Knowledge in Physics and the Economy," Phys Today, XV (July, 1962), 36-46.

The changing relationship between physics and the economy and the new roles of the physicist and the research director.

EBERHARD, John P. "Technology for the City," IST, LVII (September, 1966), 18-29.

A systems approach to the building of cities to reconcile technology and human values, including the role of the federal government.

FEIBLEMAN, James K. "Importance of Technology," Nature, CCIX (January 8, 1966), 122-125.

The nature of technology, its indispensability to science and other fields, and the need for understanding the proper uses of technology and determining to what needs it shall be applied.

HEARLE, J.W.S. "Interaction of Technologies," Nature, CCVII (September 18, 1965), 1229-1232.

Shows "how the materials technologies interact with other technologies in use, and in the methods used to process materials."

HOGG, Quintin McGarel, (Lord HAILSHAM). "Specific Present and Foreseeable Impacts of Science on Political Life," Nature, CCIII (July 11, 1964), 119-123.

The various facets of this impact which the author believes gives rise to the need for a common culture.

LAMB, Carl J. "Engineers Will Mold the Future," Sci Am, CLXXVII (November, 1947), 197-200.

Utilization of engineering skills will help the U.S. conserve scarce natural resources and reduce production costs.

LESOURNE, J. "The Place of Operational Research in the Development of Modern Society," Impact, IX (No. 4, 1959), 197-209.

Maintains that operational research has developed over several decades and outlines the influence it can have on future social development.

LIBBY, Willard F. "The Radiocarbon Story," BAS, IV (September, 1948), 263-266.

Some of the principles of radiocarbon use and the contributions they can be expected to make towards the progress of mankind.

PIEL, Gerard. "Science and the Next Fifty Years," BAS, X (January, 1954), 17-20; 25.

Outlines the prospects and challenges to be met by science.

POWELL, C. F. "Promise and Problems of Modern Science," Nature, CCXVI (November 11, 1967), 543-546.

Changing methods and increasing influence of science, the need for more fundamental research, and dangers posed by the advancement of science.

RABINOWITCH, Eugene. "Ten Years That Changed the World," BAS, XII (January, 1956), 2-6; 32.

The state of mankind after ten years of atomic energy and speculation on the future picture.

ROSENBLITH, Walter A. "On Some Social Consequences of Scientific and Technological Change," Daedalus, XC (Summer, 1961), 498-513.

Case histories illustrating the complex interrelations between technological and social variables.

ROWAN, Thomas C. "Systems Analysis in Society," Ind Res, VIII (August, 1966), 62-64; 66.

The use of aerospace problem-solving methods to solve socioeconomic problems.

SINSHEIMER, Robert, "The End of the Beginning," BAS, XXIII (February, 1967), 8-12.

A biophysicist stresses the need for prediction of the social effects of scientific advance, using molecular biology as an example.

THRING, M. W. "Mankind and Machines," Nature, CCV (March 20, 1965), 1149-1153.

"The long-term objective of the engineer must be to invent machines which contribute to the increase of human happiness."

WATSON-WATT, Robert. "Technology in the Modern World," Tech Cult, III (Fall, 1962), 385-393.

A discussion of the nature and functions of technology and its effects upon society.

4.2 AUTOMATION AND CYBERNETICS

ALBU, Austen. "Automation," Pol Q, XXVII (July-September, 1956), 250-259.

The social and economic effects of automation and the need to consider the human aspects of the changes it brings.

BARKIN, Solomon. "Manpower and Management in an Automated Age," OECD Observer, No. 14 (February, 1965), 21-24.

An assessment of the impact of automation on job content and structure and suggested guidelines for a manpower policy.

BLACK, G. and D. R. JUDD. "Computer Networks," Sci Journal, III, No. 9 (September, 1967), 35-40.

Nation-wide computer networks will provide the user with immediate access to a wide range of computer facilities.

BOWDEN, B. V. (Lord BOWDEN). "The Impact of Automation," Adv Sci, XVIII (March, 1962), 543-556.

A plea for more scientific and technical training facilities in England and a greater role for planning technological developments.

BRINCKLOE, W. D. "Automation and Self-Hypnosis," PAR, XXVI (September, 1966), 149-155.

Studies of the impact of computers and automation on society have not been scientific.

BUCKINGHAM, Walter. "The Human Side of Automation," Cybernetica, IV (No. 1, 1961), 56-70.

Effects of automation on commerce, on management, and on labor.

CHERRY, E. Colin. "The Scientific Revolution--and Communication," Nature, CC (October 26, 1963), 308-312.

The automation revolution is about to begin, and mass communications will be responsible for spreading it world-wide.

CHURCHMAN, C. W. and R. L. ACKOFF. "Purposive Behavior and Cybernetics," Soc Forces, XXIX (October, 1950), 32-39.

The application of cybernetics to studies in social science and psychology, and the need to establish definitions that can integrate disciplines.

COHEN, John. "The Scientific Revolution and Leisure," Nature, CXCVIII (June 15, 1963), 1028-1033.

Positive and negative potentialities of the increasing amount of leisure.

DIEBOLD, John. "Automation: Preceiving the Magnitude of the Problem," Cybernetica, VIII (No. 3, 1965), 150-156.

Automation involves not only technological, but social change, which must be faced by both the private and the public sectors.

________. "The Economic Consequences of Automation," Cybernetica, II (No. 1, 1959), 5-21.

Good and bad effects of automation on employment and suggested steps for lessening resistance to it.

DIEBOLD, John. "Education for Data Processing: The Real Challenge to Management," *Cybernetica,* I (No. 1, 1958), 32-38.

Automation in business calls for better-educated men who can adapt to rapid change.

DUCASSÉ, Pierre. "Science, Technology and Leisure," *Impact,* No. I (Spring, 1952), 26-42.

The balance between science and leisure, science in opposition to leisure, and the increase of leisure in the neo-technical world. Biblio.

FEINGOLD, Victor. "Automation - A Dilemma in the United States," *Lex et Sci,* II (April-June, 1965), 114-131.

The impact of automation on the labor force and measures to solve the problem of unemployment.

FOGEL, Ephim G. "The Humanist and the Computer: Vision and Actuality," *ABS,* IX (December, 1965-January, 1966), 37-40.

Sees the computer as the most promising instrument for closing the gap between the scientist and the humanist.

GABOR, Dennis. "Technology, Life and Leisure," *Nature,* CC (November 9, 1963), 513-518.

Can technology, which has changed man's daily life for the better, promote man's well-being when automation has brought about an excess of leisure?

GIFFARD, J.A.H. (Earl of HALSBURY). "Automation - Verbal Fiction, Psychological Reality," *Impact,* VII (December, 1956), 179-201.

Shows how, as a material reality and source of wealth and a psychological reality and source of fear, automation can coalesce by the application of social science.

GORDON, William E. "Economic and Social Effects of Automation," *Cybernetica,* VII (No. 4, 1964), 263-284.

Unemployment, leisure, the changing role of government, fear of insecurity, conformity, and power and class formation.

HAMMING, R. W. "Controlling the Digital Computer," Sci Mon, LXXXV (October, 1957), 169-175.

What modern, general-purpose digital computers can be expected to do, how to control them, and current problems involved in their use.

HARDER, E. L. "Computers and Automation," Impact, X (No. 1, 1960), 3-15.

Role of electronic computers in industry and business and an assessment of automation in manufacturing and management processes.

HOVNE, Auner. "Some Social Implications of Automation," Impact, XV (No. 1, 1965), 5-25.

The effects of automation on employment, labor and business, the character of government, and the life of the individual.

KILLINGSWORTH, Charles C., ed. "Automation," Annals, CCCXL (March, 1962), (entire issue).

Fourteen articles on the nature and impact of automation.

LEONTIEF, Wassily. "Machines and Man," Sci Am, CLXXXVII (September, 1952), 150-160.

Conjectures about the economic and social impact of automation on the U.S. and the world.

LEVY, Ernst. "A Response to 'The Threat and Promise of Cybernetics'", MCMT, XXII (November-December, 1965), 48-50.

LILLEY, S. "The Scientific Revolution and Industrial Processes," Nature, CXCVIII (June 22, 1963), 1132-1137.

The problems of using automation to bring about full employment and a universally higher standard of living rather than mass unemployment and shortages of skilled and professional people.

LOCKSPEISER, Ben. "Man and His Machines," Adv Sci, XII (December, 1955), 307-310.

The applications of electronic computers and the social, economic, and educational problems involved.

McCARTHY, John. "Information," Sci Am, CCXV (September, 1966), 65-72.

The capabilities of computers and their impact upon society.

MANGUM, Garth L. "Automation, Employment, and Human Values," Ed Rec, XLV (Spring, 1964), 122-127.

Automation calls for new kinds of employment which make possible applying technology towards realizing the best of human values.

MANN, Floyd C. and L. Richard HOFFMAN. "Individual and Organizational Correlates of Automation," JSI, XII, No. 2 (1956), 7-17.

Study of the impact of automation in a new power plant.

MARGERISON, Tom A. "Hopes and Fears for the Age of Leisure," Pol Q, XXXVIII (January-March, 1967), 72-80.

The impact of technology on production workers and some ways of employing those who will be displaced by automation.

MILLER, George A. "Computers, Communication, and Cognition," Adv Sci, XXI (January, 1965), 417-430.

The social and political implications of computer technology.

MOOR, Edgar J. "The International Impact of Automation," Lex et Sci, IV (January-March, 1967), 10-14.

MOOS, S. "Automation and Employment," Pol Q, XXXV (January-March, 1964), 80-86.

The effects of automation on the labor market and the need for several types of countermeasures to meet different types of unemployment.

NAGEL, Ernest. "Automatic Control," Sci Am, CLXXXVII (September, 1952), 44-47.

Author explains the basics of automation and outlines the benefits and social evils accompanying this new technology.

Organization for Economic Cooperation and Development. "Advance Preparation for Automation in Europe," *OECD Observer,* No. 21 (April, 1966), 44-46.

Summary of an OECD Conference on automation which was intended as "one effort to lay the groundwork for sound introduction of automated processes."

———. "The Impact of Automation," *OECD Observer,* No. 14 (February, 1965), 19-20; 25-26.

Report of a conference on North American experiences. Includes excerpts from speeches by Thorkil KRISTENSEN, Willard WIRTZ, and Allan J. MacEACHEN.

———. "A Survey and Its Results: The Social Consequences of Office Automation," *OECD Observer,* No. 1 (November, 1962), 32-33.

Résumé of the findings of a survey on the impact of office automation on non-manual staff.

OZBEKHAN, Hasan. "Automation," *Sci Journal,* III, No. 10 (October, 1967), 67-72.

The future development, use, and impact of computers.

Public Administration Review. "Electronic Data Processing," *PAR,* XXII (September, 1962), 129-152.

Papers from a symposium including: EDP: Implications for Public Administration by Lowell H. HATTERY; Policy Decisions and EDP Systems in the Federal Government by Frank W. REILLY; Introducing Continuous Change in Pennsylvania by Barton A. FIELDS; Building the EDP Future in New York State by Donald AXELROD; The Challenge of Obsolescence in New Orleans by Robert E. DEVELLE; The Metropolitan Data Center Projects by Robert L. WEGNER; and A Data Processing System for State and Local Governments by Edward F.R. HEARLE.

PICCIOTTO, S. de. "International Conference on Information Processing," *Impact,* X (No. 1, 1961), 53-74.

Held at UNESCO headquarters, June 15-20, 1959 to discuss the important place of electronic computers in science, technology, and industry.

ROSE, John. "Effective Automation," Sci Journal, I, No. 8 (October, 1965), 81-86.

The prospects for automation releasing men from subhuman tasks are impressive, but must be accompanied by programs for retraining and the reorientation of attitudes.

ROSENHEAD, L. "Society and the Calculating Machine," Adv Sci, X (March, 1954), 421-433.

Various kinds of calculating machines and their uses in science and administration.

RUZIC, Neil P. "Automata," Ind Res, I, No. 2 (Spring, 1959), 46-59.

Work done by W. Ross ASHBY and Frank ROSENBLATT in conceiving and constructing self-organizing systems -- automata. (See also FOGEL, Lawrence J., "Autonomous Automata," ibid., IV, No. 2 (February, 1962), 14-19, and PICARD, Robert G., "The Trend of the Revolution: Automation in the Laboratory," ibid., IV, No. 6 (June, 1962), 41-45, for discussions of the potential uses of automata.)

SANTESMASES, J. García. "A Few Aspects of the Impact of Automation on Society," Impact, XI (No. 2, 1961), 107-126.

Automation in industry will free man from routine work, but this development depends on social and economic adaptation to the situation.

SILVERMAN, William. "The Economic and Social Effects of Automation in an Organization," ABS, IX (June, 1966), 3-8.

The effect of automation on employment; the skill and training required for a job; the quality of work; job satisfaction; working conditions; earnings; and organizational structure.

SILVEY, Ted. F. "Automation: The Three-Legged Stool," Cybernetica, VI (No. 3, 1963), 133-157.

Three facets of automation: replacement of human physical strength; extension of human perception; extension and replacement of brain functions.

SILVEY, Ted F. "Labor and Our Automated Society," Cybernetica, IX (No. 1, 1966), 5-23.

An address to the 12th Annual Joint Engineering Management Conference showing the relationship of automation to private and to public enterprise.

SPINRAD, Robert J. "The Computer and You," Phys Today, XVIII (December, 1965), 47-54.

Results of a survey of scientists' attitudes toward the computer.

STERN, James. "The Automation Controversy," Ind Res, II, No. 1 (February-March, 1960), 50-56.

A labor union official's views of automation. (See also idem., "End or a New Day in Unionism?", Annals, CCCL (November, 1963), 25-35, for a review of the problems presented to unionism by automation and the changes it will bring.)

TAYLOR, Graham C. "Work and Leisure in the Age of Automation," MCMT, XXII (May-June, 1966), 116-119.

THEOBALD, Robert. "The Economic and Social Impact of Cybernetics," MCMT, XXII (November-December, 1965), 43-47.

________. "Human Rights in a Cybernated Age," Ed Rec, XLV (Spring, 1964), 113-121.

Essential human rights in a "cybernated" age include an assured income, development of full intellectual potential, and meaningful work.

________. "The Threat and Promise of Cybernation," MCMT, XXI (September-October, 1964), 3-9.

TUSTIN, Arnold. "Economic Regulation through Control-System Engineering," Impact, IV (Summer, 1953), 83-110.

Causes of the fluctuation of economic quantities, and the close analogy existing between economic models and certain physical systems that depend on the principle of feedback.

VALLÉE, Robert. "Cybernetics and the Future of Man," Impact, III (Autumn, 1952), 171-180.

Cybernetics has changed the structure of society by giving man fuller control over nature and leaving him with the problem of adapting himself to the new environment he has created.

VEILLETTE, Paul T. "The Impact of Mechanization on Administration," PAR, XVII (Autumn, 1957), 231-237.

The stages of data processing, its use in the Connecticut state government, and its impact on organization and administration.

WATT, Kenneth E.F. "Computers and the Evaluation of Resource Management Strategies," Am Sci, LII (December, 1964), 408-418.

Computer simulation studies are especially suited to problems of systems management in such fields as agriculture, wildlife management, and epidemiology.

ZVORIKINE, A. "Science as a Direct Productive Force," Impact, XIII, No. 1, (1963), 49-60.

Science is now the decisive productive force creating tools which will bring about production without machinery and leave man merely to design, manufacture, and improve automatic systems in chemical - mechanical technology.

4.3 INNOVATION AND TECHNOLOGICAL FORECASTING

AYRES, Eugene. "Social Attitude Toward Invention," Am Sci, XLIII (October, 1955), 521-540.

Case histories illustrating the reluctance with which inventions have been accepted, and a plea for the encouragement of inventiveness.

BOWN, **Ralph.** "The Transistor as an Industrial Research Episode," Sci Mon, LXXX (January, 1955), 40-46.

Describes the emergence of the transistor as a product of its time and environment and indicates the lessons to be drawn from this experience.

BROOKS, Harvey. "Applied Science and Technological Progress," Science, CLVI (June 30, 1967), 1706-1712.

The roles of government and industry in the support and performance of applied research should be better indicated in public policy. The functions of the universities in research are also discussed.

CALDER, Nigel. "Technology and the Investor," BAS, XX (April, 1964), 47-48.

Reports on a meeting planned to bring scientists, industrialists, and investors to an understanding of their interconnected problems.

CETRON, Marvin J. "Forecasting Technology," IST, No. 69 (September, 1967), 83-92.

Methods and applications of technological forecasting, defined as "a prediction, with a level of confidence, of a technical achievement in a given time frame with a specified level of support."

COCKCROFT, John. "Scientific Research and Technological Development and the Future of Industry," Adv Sci, XIX (March, 1963), 475-480.

Three aspects of the impact of science and technology on industry: improvements in technology, development of new products, and the introduction of such new managerial techniques as the computer.

DRUCKER, Peter F. "Modern Technology and Ancient Jobs," Tech Cult, IV (Summer, 1963), 277-281.

Neither culture nor technology "inhibits the application of modern technology to the traditional crafts and pursuits," but rather the failure of technologists to apply their efforts to traditional work.

GALTUNG, Johan. "The Mankind 2000 Project," MCMT, XXII (May-June, 1966), 123-124.

JAFFE, A. J. "Technological Innovations and the Changing Socioeconomic Structure," Sci Mon, LXVII (August, 1948), 93-102.

Shows "how new inventions and new techniques affect. . .the basic occupational and industrial structure of the nation."

JANTSCH, Erich. "Technological Forecasting," OECD Observer, No. 27 (April, 1967), 33-34; 36.

Summary of survey of technological forecasting as it is practiced or under development in 13 countries. (See also idem., "Forecasting the Future," Sci Journal, III, No. 10 (October, 1967), 40-45.)

KAHN, Herman. "World Futures," Sci Journal, III, No. 10 (October, 1967), 121-125.

The assumptions and methods used at the Hudson Institute for predicting the economic futures of societies are described.

McLAUGHLIN, G.H. "Research into the Acceptance of Technical Change," Nature, CXCVIII (April 20, 1963), 238-239.

The urgency of finding the most effective way to introduce "technical change without destroying cherished belief and patterns of life."

MESTHENE, Emmanuel G. "On Understanding Change: The Harvard University Program on Technology and Society," Tech Cult, VI (Spring, 1965), 222-235.

The director of the program sketches its plans and first projects. Its purpose is "to undertake an inquiry in depth into the effects of rapid technological change on the economy, on public policies, and on the character of the society, as well as into the reciprocal effects of social change on the nature, dimension, and directions of scientific and technological development." (See also idem., "An Experiment in Understanding: The Harvard Program Two Years After," Tech Cult, VII (Fall, 1966), 475-492.)

MORTON, Jack A. "The Microelectronics Dilemma," IST, LV (July, 1966), 35-44.

Describes how the new technology of microelectronics is affecting management.

NELSON, Bryce. "Technological Innovation: Panel Stresses Role of Small Firms," Science, CLV (March 10, 1967), 1229-1231.

Small firms supply a large percentage of the nation's inventive progress.

OGBURN, William Fielding. "How Technology Changes Society," Annals, CCXLIX (January, 1947), 81-88.

The social effects of production and use of inventions and the importance of predicting these effects.

Organization for Economic Cooperation and Development. "Adjustment to Technological Development Within the Firm," OECD Observer, No. 22 (June, 1966), 34-35.

Private firms should promote an active manpower policy to minimize problems of personnel adjustment.

________. "Technological Forecasting," OECD Observer, No. 27 (April, 1967), 33-34; 36.

The implementation of technological forecasting has enabled industry to establish meaningful goals for research.

PAVITT, Keith. "Government and Technological Innovation," OECD Observer, (February, 1966), 16-20. (Special issue on science.)

The technological implementation of the results of scientific research must be encouraged by governments to promote economic and social progress.

PIERCE, John R. "Innovation in Technology," Sci Am, CXCIX (September, 1958), 117-130.

Science affects man's material existence through technological innovation.

SCHON, Donald A. "The Fear of Innovation," IST, LIX (November, 1966), 70-78.

The impact of innovation upon a corporation and the reactions of those affected.

________. "Forecasting and Technological Forecasting," Daedalus, XCVI (Summer, 1967), 759-770.

Defines technological forecasting, outlines some of the obstacles to its effectiveness, and discusses attitudes about its feasibility and usefulness.

SLICHTER, Sumner. "The Industry of Discovery," Science, CXXVIII (December 26, 1958), 1610-1613.

How technological research affects the economy and contributes to its growth and stability.

STAFFORD, Alfred B. "Is the Rate of Invention Declining?" AJS, LVII (May, 1952), 539-545.

The decline in the number of patents indicates new courses for invention in the future.

SWAGER, W.L. "Materials," Sci Journal, III, No. 10 (October, 1967), 107-112.

The challenge in predicting the future of materials is to see precisely their impact on "the materials system"; hence the author describes a "systems analysis" of the future of materials.

WHITNEY, Vincent Heath. "Resistance to Innovation: The Case of Atomic Power," AJS, LVI (November, 1950), 247-254.

Like other technological innovations, atomic power may meet with strong resistances based on economic, social, and cultural factors.

WIEBE, Gerhart D. "A Strategy for Social Psychological Research on Technological Innovation," JSI, XVII, No. 2 (1961), 56-64.

Suggests a committee to identify "incipient social problems spawned by technological innovations," and to bring such problems to the attention of appropriate groups.

WILLIAMS, Bruce Rodda. "Science and Industrial Innovation," Adv Sci, XIII (December, 1956), 156-162.

"The application of science to industry" and the effects on individual firms.

ZVEGINTZOV, M. "Management in a Modern Scientific and Technological Age," Impact, XI (1961), 53-73.

Examines impact of science and technology on management, concluding that management must adapt itself to their rapid change and progress.

4.4 COMMUNICATION AND TRANSPORTATION

BISLINGHOFF, R.L. "The Supersonic Transport," Sci Am, CCX (June, 1964), 25-35.

Shows the technical feasibility of supersonic transport but warns that technology is not advanced enough to produce an SST economically useful to the airlines.

BOULADON, Gabriel. "Transport," Sci Journal, III, No. 10 (October, 1967), 93-99.

A forecast of the changes possible in transportation by the end of the century, the most important innovation being government legislation forcing transportation into harmony with its environment.

________. "The Transport 'Gaps'", Sci Journal, III, No. 4 (April, 1967), 41-46.

Environmental problems call for a unified theory of transportation to help identify "transport gaps" in which present vehicles are unsuitable.

COGHILL, Nelson. "The Thunderers," New Sci, XXXIV (June 29, 1967), 768-770.

The effect of noise on the community near a London airport and steps for Parliament to prevent the annoyance and possible danger of crashes in residential areas.

CROCHET-DAMAIS, P. "Commercial Aviation and Life on our Planet," Impact, II (April-June, 1952), 38-39.

Human and economic geography and geo-political theories have been changed by air transport.

EZRATTY, S. "Films and Society," Impact, XIII (No. 2, 1963), 147-169.

History of the film industry, an account of production and subject choice, and good and bad social impacts of films and the potential afforded by the cinema.

________. "Television and Society," Impact, XV (No. 3, 1965), 149-172.

The impact of television and the need for more responsible consideration of its social effects.

HERBERT, Evan. "Transporting People," S+T (IST), No. 46 (October, 1965), 30-42.

"New government support for transportation R & D is spurring plans for integrating present subsystems, for using faster vehicles, and for developing radically new systems."

HOHENEMSER, Kurt H. "The Supersonic Transport," BAS, XXII (December, 1966), 8-12.

The important issues arising from the development of SST and the problems of the technological background. (See also idem., "Supersonic Transport," Sci Cit, VIII (April, 1966), 1-10, where SST as a commercial success or as a symbol of national prestige is considered.

LUNDBERG, B.K.O. "The Supersonic Adventure," BAS, XXI (February, 1965), 29-33.

Discussion of various unfavorable aspects of SST.

LYNCH, Charles J. "Noise Control," IST, No. 52 (April, 1966), 32-41.

Noise is not generally harmful, but steps can be taken to reduce the annoyance from jets, other vehicles, and poorly designed buildings.

MECKLING, William. "Economic Potential of Communication Satellites," Science, CXXXIII (June 16, 1961), 1885-1892.

Communication satellites, their physical characteristics, low costs, uses, and demand.

MELLOR, R.E.H. "Some Influences of Physical Environment upon Transport Problems in the Soviet Union," Adv Sci, XX (March, 1964), 564-571.

Terrain and climate are the important factors discussed in water, railway, and air transport.

MOTT, George Fox, ed. "Transportation Renaissance," Annals, CCCXLV (January, 1963), (entire issue).

Eighteen articles on changing modes and means of transportation and the challenges they present to national policy.

Organization for Economic Cooperation and Development. "Aircraft Noise: A Menace to be Met," OECD Observer, No. 11 (August, 1964), 40-41.

Two study groups suggest sociological research into the effects of noise and of sonic booms.

OWEN, Wilfred. "Automotive Transport in the United States," Annals, CCCXX (November, 1958), 1-8.

The impact of the automobile on the economy and the way of life.

PIERCE, John R. "Communication Satellites," Sci Am, CCV (October, 1961), 90-102.

Prospects for using this means of transmitting telephone and television signals across the entire earth, which might be in operation within five years.

RICHARDS, E.J. "Sonic Boom," *Sci Journal*, I, No. 3 (May, 1965), 46-51.

An analysis of the social implications of the sonic boom and ways in which its nuisance value can be minimized.

SAMUELSON, Robert J. "The SST and the Government: Critics Shout into a Vacuum," *Science*, CLVII, (September 8, 1967), 1146-1151.

The promoters of the SST are influential people who are already beginning to feel the projects' benefits, whereas the projects' opponents can only argue on what they *think* will be its drawbacks.

SCHILLER, Herbert I. "Communications Satellites: A New Institutional Setting," *BAS*, XXIII (April, 1967), 4-8.

The traditional orientation of U.S. policy on communications satellites and the need for a new outlook in domestic and in international communications.

SHEPHERD, E. Colston. "The Boom of Supersonic Airliners and the Freedom of the Air," *New Sci*, XIX (August 15, 1963), 329-331.

Sonic booms and the need for national policy regarding overflight of supersonic airliners.

STEINMAN, D.B. "How Bridges Have Increased Man's Mobility," *Sci Mon*, LXXV (October, 1952), 207-214.

The growth and improvement of bridge building through the centuries, showing how bridges influence the expansion of cities and the prosperity of nations.

TCHISTIAKOV, Nicolai I. "Hurdles in Space Broadcasting," *Courier*, XIX (November, 1966), 30-32.

The use of satellites for broadcasting and the problems involved.

WARNER, E. "Some Social Consequences of the Aeroplane," *Adv Sci*, VIII (December, 1951), 319-323.

Stresses the importance of air travel for commercial and governmental activity and the potential benefits for international relations.

WILSON, Herbert A. "Sonic Boom," *Sci Am*, CCVI (January, 1962), 36-43.

The problem of keeping objectionable sonic boom from ground level before supersonic transport can be put into regular service.

4.5 ASTRONAUTICS AND ASTRONOMY

BERMAN, Arthur I. "Observatories in Space," Sci Am, CCIX (August, 1963), 28-37.

The coming launching of Orbiting Astronomical Observatories is hailed by astronomers as it will overcome limitations placed on earthbound instruments.

BOYD, R.L.F. "Celestial Laboratories," Nature, CXCVIII (April 6, 1963), 4-10.

The evolution of space research and a brief example of the uses made of sky laboratories.

CLARKE, Arthur C. "The Challenge of the Spaceship," Impact, IV (Spring, 1953), 15-28.

The current situation and predictions for the future.

DORNBERGER, Walter R. "The Case for Military Power in Space," Ind Res, IV, No. 5 (May, 1962), 18-23.

Arguments for U.S. efforts to develop military offensive capability in space.

DRYDEN, Hugh L. "Future Exploration and Utilization of Outer Space," Tech Cult, II (Spring, 1961), 112-126.

An "assessment of the future of astronautics."

FISHLOCK, David. "The 'Fall-Out' from the Space Race," New Sci, XVIII (May 30, 1963), 480-481.

The technological benefits claimed by the U.S. space program which are not substantial enough to justify the vast amounts of money being spent.

GOLDSEN, Joseph M. "Some Social Implications of the Space Program," ABS, VI (March, 1963), 3-17.

Summary reports of the Working Group on Social, Economic and Political Implications from a summer study group to review problems in space research and policy.

LOVELL, Bernard. "The Challenge of Space Research," Nature, CXCV (September 8, 1962), 935-939.

The scientific benefits from space research and a caution against risking scientific progress by military or commercial exploitation of space activity.

LOVELL, Bernard. "Changing Patterns in Space Exploration," New Sci, XXIII (July 9, 1964), 79-80.

Recent developments in Soviet and American space programs and potentialities for the European program.

MEINEL, Aden Baker. "New Frontiers of Astronomical Technology," Science, CXXXIV (October 20, 1961), 1165-1171.

The advances made in this field.

MURRAY, Bruce C. and Merton E. DAVIES. "A Comparison of U.S. and Soviet Efforts to Explore Mars," Science, CLI (February 25, 1966), 945-954.

How the U.S. effort remains minimal despite early success, while the Soviet effort remains large despite early failures.

Nature. "Contamination by Extra-Terrestrial Exploration," Nature, CLXXXIII (April 4, 1959), 925-928.

Recommendations of a committee of the International Council of Scientific Unions for the prevention of contamination of the moons and planets.

NEWELL, Homer E. "The Satellite Project," Sci Am, CXCIII (December, 1955), 29-33.

The possible uses of a satellite, such as measurements, cosmic rays, measuring the earth's magnetic field, ultraviolet light, meteorite bombardment.

PICKERING, W. H. "The Selection of Space Experiments," Am Sci, LIV (March, 1966), 103-109.

The problems involved in a large government-sponsored scientific effort.

RUZIC, Neil P. "The Case for Going to the Moon," Ind Res, VI, No. 8 (September, 1964), 68-92.

First of six articles on lunar exploration, giving practical reasons for lunar exploration. (Following articles by same author include "The Case for Going to the Moon," ibid., VI, No. 9 (October, 1964), 68-79, which envisages profitable manufacturing operations on the moon; "The Case for Mining the Moon," ibid., VI, No. 10 (November, 1964), 86-110, on the possibilities of profitable mineral extraction from the moon; "The Case for Seeing the Universe," *ibid.*, VI, No. 11 (December, 1964), 66-82, dealing with the unique opportunities for astronomical observations on the moon; "The Case for Life Beyond the Earth," *ibid.*, VII, No. 1 (January, 1965), 64-80, which is concerned with the possibility of extraterrestrial life on the moon; and "The Case for Technological Transfer," *ibid.*, VII, No. 3 (March, 1965), 67-87, which explains how and why space science and engineering knowledge can be transferred profitably into the industrial and social sectors of present life.)

SCHWARTZ, Leonard E. "Manned Orbiting Laboratory -- For War or Peace? " *Int Aff,* XLIII (January, 1967), 51-64.

Discusses Soviet and American programs for manned military space stations which were not prohibited by the treaty on peaceful uses of outer space.

SELLS, Saul B. "Some Implications of Astronautical Research for Human Affairs," *JSI,* XVII, No. 2 (1961), 15-23.

Problems of the impact of space technology on politics, economics, and social and cultural life.

SHEPHERD, E. Colston. "The Concord as an Economic Asset," *New Sci,* XXXVI (December 14, 1967), 645-647.

Describes the Anglo-French supersonic airliner project.

SHOEMAKER, Eugene M. "Exploration of the Moon's Surface," *Am Sci,* L (March, 1962), 99-130.

Motivations for the U.S. moon program, scientific objectives, and the probable course of the program.

SMITH-ROSS, R. L. "Allocation of Frequencies for Radio Astronomy and Space Science," *Nature,* CCIII (July 4, 1964), 7-11.

Problems from the development of space communications and the interests of radio astronomy.

STRONG, James. "The Soviet 'Space Bomb'," *New Sci,* XXXVI (November 16, 1967), 424.

Discusses the Soviet Union's new sub-orbital missile and its implications.

VAN ALLEN, James A. "The Artificial Satellite as a Research Instrument," Sci Am, CXCV (November, 1956), 41-47.

The research advantages of a satellite and the limits on design and behavior of the satellite are discussed.

VonBRAUN, Wernher and Frederick I. ORDWAY, III. "Astronautical Fallout," BAS, XVIII (November, 1962), 13-17.

Discusses the advantages to man to be derived from research in astronautics.

4.6 ENERGY

4.6.1 GENERAL

BAUM, V. A. "Solar Energy Today and Tomorrow," Courier, XI (September, 1958), 4-6.

A Soviet scientist describes progress in the practical uses of solar energy.

CALDER, Ritchie. "Impressions of the World Power Conference," New Sci, II (June 13, 1957), 11-13.

Account of a conference held in Yugoslavia to consider power resources.

DANIELS, Farrington. "Chemistry and World Energy Needs," CEN, XXXV (April 29, 1957), 14-19.

Chemists can contribute to the peace of the world by forestalling the too-rapid end of our fossil fuels and by furthering new sources of energy.

EGERTON, Alfred. "Civilization and the Use of Energy," Adv Sci, VII (March, 1951), 386-397.

Begins with man's possession of fire and concludes with the prospect for world society and the satisfaction of all material needs through the use of energy.

GREEN, Leon, Jr., "Energy Needs versus Environmental Pollution: A Reconciliation?" Science, CLVI (June 16, 1967), 1448-1450.

Energy concept proposal to reduce pollution of air and water.

HARTLEY, Harold. "Energy in the Service of Man," *Impact,* I (July and September, 1950), 37-38.

Technical sessions of the Fourth World Power Conference which was concerned with energy resources and development.

________. "Man's Use of Energy," *BAS,* VI (November, 1950), 322-324.

Conservation of existing energy resources and tapping solar and nuclear sources.

HEYWOOD, Harold. "Solar Energy: A Challenge to the Future," *Nature,* CLXXX (July 20, 1957), 115-118.

The technical aspects of solar energy use and its future possibilities.

Impact of Science on Society. "Man's Use of Energy," *Impact*, I (October-December, 1950), 117-118.

Report of symposium at Salisbury, Southern Rhodesia, where various sources of available energy in Africa were discussed.

LÖF, George O. G. "Profits in Solar Energy," *Res Man,* I (Winter, 1958), 235-250.

Discusses potential uses and developments of solar energy.

Organization for Economic Cooperation and Development. "Some Aspects of United States Energy Policy," *OECD Observer,* No. 28 (June, 1967), 27-31.

Policy decisions, resulting from the commercial availability of new types and sources of energy and the growing problems of pollution, will have to be made soon

SCARLOTT, Charles A. "Changing Energy Scene," *Sci Mon,* LXXXIV (May, 1957), 221-228.

Since energy shortages will not be eliminated by the use of atomic power, the most energy possible must be obtained from all possible sources.

SCHURR, Sam H. "Energy," *Sci Am,* CCIX (September, 1963), 111-126.

Estimates future world consumption of energy as compared with energy resources.

SINNOTT, Edmund W. "Man and Energy," Yale Rev, XXXVIII (June, 1949), 640-653.

The scientific, moral, and philosophical problems of the power age.

SORRE, Max. "The Technology and Geography of Energy," Impact, I (October-December, 1950), 111-114.

"Each success in the field of energy represents a victory over the resistance offered by inanimate objects and over the obstacle of space; it thus concerns the geographer."

TELKES, Maria. "Future Uses of Solar Energy," BAS, VII (August, 1951), 217-219.

Discusses the conversion of solar energy into useful energy forms.

TIRASPOLSKY, W. "Energy as the Key to Social Evolution," Impact, III (Spring, 1952), 5-17.

The human race has passed through five stages in the mastery of the internal energies of matter subsequent to its exploitations of muscular and mechanical energy.

TROMBE, Felix. "Some Aspects of the Uses of Natural Radiation, Especially in the Developing Countries," Impact, XV, No. 4 (1965), 247-260.

The use of solar and terrestrial energy can supplement conventional energy resources or substitute for them.

WHITE, Leslie A. "Energy in the Development of Civilization," Impact, I (July-September, 1950), 38-40.

A culture becomes more highly developed as more energy is harnessed.

4.6.2 NUCLEAR

ALLISON, Samuel K. "Nuclear Power and the Next Twenty Years," BAS, XVIII (December, 1962), 13-14.

Believes nuclear power will bring about the destruction of mankind.

BEATON, Leonard. "Nuclear Proliferation," Sci Journal, III, No. 12 (December, 1967), 35-40.

Many countries which are acquiring commercial nuclear power installations are also acquiring the wherewithal to make plutonium bombs.

BHABHA, Homi Jehangir. "The Promise of Nuclear Energy," Courier, XVI (July-August, 1963), 14-17.

Suggestions for a policy for energy development of underdeveloped nations, many of which have inadequate supplies of conventional power resources.

BRODIE, Bernard. "The Atomic Dilemma," Annals, CCXLIX (January, 1947), 32-41.

Presents several proposals for national policy concerning atomic energy development and control.

COCKCROFT, John. "Future of Atomic Energy," Sci Mon, LXXXII (March, 1956), 136-141.

The importance of atomic energy for peaceful purposes, the value of international cooperation, and the many promising fields of application.

COHEN, Karl. "Atomic Power as a Risk Venture," BAS, IX (October, 1953), 305-308.

The risk element in developing atomic power is financial rather than biological, but the author believes it will be profitable.

COMPTON, Arthur H. "Atomic Energy as a Human Asset," Nature, CLVII (February 9, 1946), 146-151.

The effects of atomic energy: world political structure to ensure peace; technological applications; and sociological effects.

________. "Nuclear Energy and the Growth of Man," Nature, CLXXX (November 30, 1957), 1157-1159.

Substance of an address covering the peaceful uses of atomic energy.

DAHL, Robert A., ed. "The Impact of Atomic Energy," Annals, CCXC (November, 1953), (entire issue).

Sixteen articles on the subject.

DAVIS, W. Kenneth, Shields WARREN, and Walker L. CISLER. "Some Peaceful Uses of Atomic Energy," Sci Mon, LXXXIII (December, 1956), 287-297.

Industrial applications of atomic power, medical uses, and international cooperation in atomic energy.

FRIEDLANDER, Michael. "Nuclear Digging," Sci Cit, VII (November, 1964), 1-16.

Project Plowshare and the advantages and disadvantages of nuclear excavation.

GLENNAN, T. Keith. "Industry's Next Step in Atomic Energy," CEN, XXX (December 15, 1952), 5240-5243.

Discusses the role industry must assume if atomic energy is to become competitive in the production of power.

GREBE, John J. "Atomic Energy--Applied," CEN, XXXIX (October 8, 1951), 4154-4157.

By using atomic energy the productivity of industry can be greatly increased.

HART, Hornell. "Technological Acceleration and the Atomic Bomb," ASR, XI (June, 1946), 277-293.

The atomic bomb as a dramatic manifestation of technological acceleration and the need for increasing cultural acceleration in other fields to avoid catastrophe.

Impact of Science on Society. "Social and Economic Aspects of Isotope Utilization," Impact, VIII (No. 4, 1957), (entire issue.)

Includes: Introduction by Pierre AUGER; The Future of Atomic Energy by John COCKCROFT; The Economic Aspects of Radio-Isotope Utilization by W.F. LIBBY; Radiation Exposure and the Uses of Radio-Isotopes by Lauriston S. TAYLOR; Isotopes and Radiation Energy in Industry by Henry SFLIGMAN; and The Significance of Atomic Energy for Food and Agriculture by R. A. SILOW.

INGLIS, David R. and Carl L. SANDLER. "Prospects and Problems: The Nonmilitary Uses of Nuclear Explosives," BAS, XXIII (December, 1957), 46-53.

A special report on Project Plowshare.

JOHNSON, Gerald W. "Nuclear Explosions in Science and Technology," BAS, XVI (May, 1960), 155-161.

The findings of the Plowshare program, which was established to explore the feasibility of potential industrial and scientific uses of nuclear and thermonuclear explosions in various environments.

________. "Possible Uses of Nuclear Explosions for Excavations," Sci Cit, III (June, 1961), 2.

Excerpts from the author's statement before the Hearings on Frontiers in Atomic Energy Research, Joint Congressional Committee on Atomic Energy, March 22-25, 1960.

JOHNSON, Gerald W. and Harold BROWN. "Non-Military Uses of Nuclear Explosions," Sci Am, CCI (December, 1959), 29-35.

The Plowshare program of AEC is studying constructive uses of nuclear explosions, e.g., excavation of harbors, power production and mining.

JOHNSON, Gerald W. and Gary H. HIGGINS. "Useful Nuclear Explosives," S+T (IST), No. 38 (February, 1965), 54-60.

Progress made under the Atomic Energy Commission's Plowshare program to explore the usefulness of nuclear explosives as engineering tools.

LOMBARD, David B. "Plowshare: A Program for the Peaceful Uses of Nuclear Explosives," Phys Today, XIV (October, 1961), 24-34.

Possible use of nuclear explosives for excavation, mining, recovering petroleum, and control of water resources.

MANLEY, J. H. "One Atom and Many," Sci Mon, LXVI (January, 1948), 47-53.

The interaction between the scientific achievements in atomic energy research and society.

MENKE, John R. "Nuclear Fission as a Source of Power," BAS, IV (April, 1948), 115-121.

Reprinted from ECONOMSTRIKA (no date given). Presents preliminary estimates of the economic importance of nuclear energy. Extensive bibliography.

MERRIAM, Charles E. "Physics and Politics," APSR, XL (June, 1946), 445-457.

The impact of atomic energy development upon political life and the need for physics and politics to be concerned with issues of human freedom, planning for peace-time development, and world government.

NELSON, Thomas. "Nuclear Technology: An Economic Catalyst: Part I; The Cold War and Foreign Investment," BAS, XIII (May, 1957), 157-161.

The teamwork between public and private investment, partly catalyzed by nuclear technology, has accelerated the industrial processes.

NOVICK, Sheldon. "'Breeding' Nuclear Power," Sci Cit, IX (June-July, 1967), 97-105.

Discusses the implications for the future of civilian nuclear power of the Fermi reactor.

OSWALD, William. "Economic Prospects for Nuclear Power," New Sci, III (February 27, 1958), 25-27.

Recommends development policy in economic nuclear power for the United States and for Britain.

PEIERLS, R. E. "Atomic Energy -- Threat and Promise," Endeavour, VI (April, 1947), 51-57.

The destructive and constructive uses of atomic energy and the need for research to open up new possibilities.

POST, Richard E. "Fusion Power," Sci Am, CXCVII (December, 1957), 73-84.

How laboratories throughout the world are attempting to tame the reactions in which the nuclei of atoms are fused rather than split because this will provide an almost limitless source of energy.

SCHURR, Sam H. "The Economics of Atomic Power," Sci Am, CLXXXIV (January, 1951), 32-38.

A summary of the Cowles Commission study. Effects of producing energy compared to coal use in the iron and steel industry and household heating on investment, on backward areas, and on the international scene.

Scientist and Citizen. "Project Chariot: The Known and the Unknown--The Nature of Nuclear Decision," Sci Cit, III (June, 1961), 1-4.

This project is part of the Plowshare program for the development of peaceful uses of nuclear explosions.

SHILLING, C. W. "Everybody's Business," AIBS Bulletin, VII (June, 1957), 9-12.

Discusses the hazards and benefits of radiation and urges a calm and rational attitude toward the inevitable use of atomic energy.

THOMAS, Charles Allen. "Radioisotopes: New Tools for Science," CEN, XXV (June 2, 1947), 1572-1574.

Discusses some of the frontiers in fields created by atomic energy development--medicine and biology, photosynthesis, and detecting pollution of water supply.

THOMSON, George. "Nuclear Energy and Its Uses," Int Aff, XXII (July, 1946), 315-325.

Processes involved in harnessing atomic energy and its uses in war and in peace.

WALTERSCHEID, Edward E. "Nuclear Excavation," Ind Res, VIII (January, 1966), 54-59.

Problems and prospects for nuclear excavation techniques, including test requirements for "clean" nuclear devices.

WARREN, Shields. "Atomic Energy in War and Peace: Medical Aspects," JAMA, CXLV (January 13, 1951), 61-62.

The promising uses of atomic energy in medical research and the civil defense aspects of medical service in atomic war.

WEINBERG, Alvin M. "The Outlook for Industrial Nuclear Power-1954," Am Sci, XLII (July, 1954), 461-470.

Peacetime development of nuclear technology may, if properly developed politically, lower world tensions by de-emphasizing military aspects of nuclear energy.

WIGNER, Eugene P. "Impact of the Developments in Atomic Energy on the Sciences," BAS, VII (March, 1951), 66-69; 80.

The stimulating influences that the technical accomplishments of atomic energy have had on many branches of science.

4.7 RESOURCES AND THE ENVIRONMENT

4.7.1 GENERAL

Advancement of Science. "Effects on Agriculture of Changes in the Balance of Nature," *Adv Sci*, XIII (June, 1957), 439-451.

Abridged versions of three papers: Ecological Research and Farming, by E. M. NICHOLSON; The Natural and Artificial Control of Vertebrate Pests in Agriculture, by I. THOMAS; Insect Pest Balance in Agriculture, by A. H. STRICKLAND.

BEAVER, S. H. "Rehabilitation of Derelict Land," *Nature*, CLXVI (October 4, 1950), 630-632.

The symposium of the British Association discusses ways in which to make derelict land productive.

BLACKMAN, Allan, ed. "Environment and Behavior," *ABS*, X (September, 1966), (entire issue).

(Note especially Selected Bibliography on Environmental Knowledge and Planning, 31.)

BROOKS, Douglas L. "Environmental Quality Control," *BioSci*, XVII (December, 1967), 873-877.

Describes the gradual changes of "environmental decay" and suggests an approach to its control.

CALDWELL, Lynton K. "Biopolitics: Science, Ethics, and Public Policy," *Yale Rev*, LIV (October, 1964), 1-16.

Biopolitics is the art of giving political answers to biological questions. Such political answers--wise or unwise--come about because biology does not always provide answers to the questions it raises.

________. "Environment: A New Focus for Public Policy?" *PAR*, XXIII (September, 1963), 132-139.

Describes present principles and points of view for dealing with environmental policy decisions and suggests a more comprehensive approach.

CALDWELL, Lynton K. "Problems of Applied Ecology: Perceptions, Institutions, Methods, and Operational Tools," *BioSci*, XVI (August, 1966), 524-527.

The accelerating speed of environmental change indicates the need for applying ecological concepts. Analyzes obstacles to applied ecology.

CASSIDY, Harold G. "On Incipient Environmental Collapse," *BioSci*, XVII (December, 1967), 878-882.

The tools of systems theory are needed to cope creatively with present environmental crises.

COMMONER, Barry. "Duty of Science in the Ecological Crisis," *Sci Cit*, IX (October, 1967), 173-182.

The increasing number of environmental problems and measures which should be taken by scientists and by society to alleviate them.

DIXEY, F. "Conservation and Utilization of World Resources," *Nature*, CLXIV (November 12, 1949), 813-815.

Report of the first United Nations conference on conservation. Details of the Minerals Section of the conference.

FEISS, Julian W. "Minerals," *Sci Am*, CCIX (September, 1963), 129-136.

Technological advance keeps creating new resources needed for an industrial society.

HALPRIN, Lawrence. "The Engineer and the Landscape," *S+T(IST)*, LXXI (November, 1967), 60-64.

HILLABY, John. "High Politics on Tortoise Island," *New Sci*, XXXIV (June 8, 1967), 584-585.

Aldabra, a small island in the Indian Ocian, is the cause of conflict between British-American plans for a defense post and the Royal Society's wishes to preserve it as a unique research laboratory.

________. "The Years of the Quiet Locust," *New Sci*, XXXVI (October 12, 1967), 98-99.

The periodicity of locust swarms and possibilities of control.

ILTIS, Hugh H. "To the Taxonomists and Ecologists Whose Fight Is the Preservation of Nature," BioSci, XVII (December, 1967), 886-890.

A plea for scientists to speak out against the destruction of nature in our technological society and to exert more influence on public policy to protect nature.

JACKSON, Henry M. "Public Policy and Environmental Administration," BioSci, XVII (December, 1967), 883-885.

The management of the environment involves choices which must be based on social, economic, and scientific considerations in a coordinated policy.

LEBRUN, J. "Natural Balances and Scientific Research," Impact, XIV, No. 1 (1964), 19-37.

Examples of man's role in disturbing the balance of nature and the resulting destructive results.

LOWDERMILK, Walter C. "The Reclamation of Man-Made Desert," Sci Am, CCII (March, 1960), 54-63.

MORISON, Robert S. "Education for Environmental Concerns," Daedalus, XCVI (Fall, 1967), 1210-1223.

Rationale for the need of new perspectives: how to make them part of educational programs.

OEDEKOVEN, K. H. "Forestry-A World Problem," Impact, XI, No. 1 (1961), 18-30.

Describes the effects of forest destruction on human society and the influence of forests on soil, climate, and water resources.

RAUSHENBUSH, Stephen, ed. "The Future of Our Natural Resources," Annals, CCLXXXI (May, 1952), (entire issue).

Twenty-four articles on conservation, mineral and energy resources, forests, soils, and water resources.

SEARS, Paul B. "Utopia and the Living Landscape," Daedalus, XCIV (Spring, 1965), 474-486.

Man's role is not to manipulate his environment but to adjust to it.

STAMP, L. Dudley. "Man and His Environment," Sci Journal, I, No. 3 (May, 1965), 76-80.

Emphasizes the need for environmental studies of the optimum conditions for physical and mental activities.

________. "The World Land Use Survey," Adv Sci, XVII (July, 1960), 171-173.

Describes a project of the International Geographical Union to make a world-wide inventory of land use.

SWANSON, C. P. "Conservation and Renewable Natural Resources," AIBS Bulletin, XII (February, 1962), 21-23.

Activities of the NAS-NRC Division of Biology and Agriculture in the areas of conservation and natural resources.

UNESCO. Natural Sciences Department. "The Role of Science in the Development of Natural Resources," Impact, XII (No. 4, 1962), 213-230.

Discusses how and why "each independent country will have to organize its own national research body to direct the study of the different aspects of its nature and natural resources."

WENGERT, Norman. "The Ideological Basis of Conservation and Natural Resources Policies and Programs," Annals, CCCXLIV (November, 1962), 65-75.

4.7.2 POPULATION AND RESOURCES

AYRES, Robert U. "Food," Sci Journal, III, No. 10 (October, 1967), 100-106.

Better utilization of crop and grazing lands and of resources from the sea will improve the outlook for an increased food supply.

CALDER, Ritchie. "Technology in Focus," Tech Cult, III (Fall, 1962), 563-580.

The possibility that the world's material problems could be solved by the proper application of science and technology.

CLAPP, Leallyn B. "Science and Human Want," Am Sci, XLVI (June, 1958), 176-190.

The U.S. can indefinitely continue its level of consumption and can bring to the underdeveloped countries the hope of supplying their human wants.

DARWIN, Charles. "Can Man Control His Numbers?" PBM, III (Winter, 1960), 252-263.

Predicts the possible trends in world population, birth control as official policy, and the new heredity over which man has control.

DAVIS, Kingsley. "Population," Sci Am, CCIX (September, 1963), 63-71.

Surveys world population growth and its effect on economic development.

DURAND, John D., ed. "World Population," Annals, CCCLXIX (January, 1967), (entire issue).

Thirteen articles on population growth, its control, and its effect on economic, technical, and social development.

EHRLICH, Paul. "Paying the Piper," New Sci, XXXVI (December 14, 1967), 652-655.

The federal government must limit the U.S. population explosion and that of the rest of the world to avoid an inevitable famine in 25 years if the present population growth continues.

FITTER, R.S.R. "The Key to Soil Fertility," New Sci, IV (September 25, 1958), 894-895.

Political aspects of soil conservation and the need to educate the public.

FREMLIN, J. H. "An Optimum Population for Britain, "New Sci, XXXVI (December 21, 1967), 717-719.

An optimum population is relative to the chosen way of life.

GREBENIK, E. "World Population and Resources," Pol Q, XXVI (October - December, 1955), 371-379.

Difficulties of attempting to control population growth and the growing pressure of population on resources in many parts of the world.

HOAGLAND, Hudson. "Mechanisms of Population Control," Daedalus, XCIII (Summer, 1964), 812-829.

An expansion of his Cybernetics of Population Control, published in BAS, XX, February, 1964.

HOAGLAND, Hudson. "Population Problems and the Control of Fertility," Daedalus, LXXXVII (Summer, 1959), 425-443.

Includes a discussion of the population problem and a report on the discovery of oral contraceptives.

HUTCHINSON, Joseph. "Land and Human Populations," Adv Sci, XXIII (September, 1966), 241-254.

The relationship of population density to land resources and conclusions that the British population must be stabilized if it is to maintain its standard of living.

KEYFITZ, Nathan. "Population Density and the Style of Social Life," BioSci, XVI (December, 1966), 868-873.

U.S. food shipments to Latin America and Asia have called dense aggregates into being in the port cities of those continents.

KILLEFFER, D. H. "Chemists Fight for Food, Forage, Fiber," Sci Am, CLXXVI (April, 1947), 157-159.

Chemical weapons are available to fight insect pests and fungi that destroy crops, but political considerations frequently prevent their effective use.

LINTON, D. L. "Population and Food in the Tropical World," Adv Sci, XVII (November, 1961), 391-401.

The social, economic, and environmental aspects of the food-population problems in the tropical world.

MATTSON, Howard W. "Food for the World," IST, No. 48 (December, 1965), 28-39.

Discusses the technological aspects of increasing food production.

MEIER, R. L. "Industrialization of Photosynthesis and Its Social Effect," CEN, XXVII (October 24, 1949), 3112-3116.

With more efficient industrial methods, utilization of photosynthesis opens up new possibilities for economic development.

MULLER, Hermann J. "Survival," AIBS Bulletin, XI (October, 1961), 15-24.

Discusses the current crisis in population, natural resources, and the genetic dilemma which is caused by aid to the weak and inferior members of society.

Organization for Economic Cooperation and Development. "Farm Motorisation," OECD Observer, No. 5 (August, 1963), 14-16.

A statistical study of technological progress in agriculture.

RAPER, Arthur. "The Role of Agricultural Technology in Southern Social Change," Soc Forces, XXV (October, 1946), 21-30.

The effects of the mechanization of cotton production upon the South.

REVELLE, Roger. "Population," Sci Journal, III, No. 10 (October, 1967), 113-120.

Human fertility, which is a key variable in projecting population growth, will determine the seriousness of future population crises according to the extent to which it is controllable.

RHIND, Donald. "The Impact of Research on Tropical Agriculture," New Sci, XXXV (September 7, 1967), 493-496.

Research in tropical agriculture has expanded considerably in this century; limited food production in Asia especially is now due more to economic than to technological factors.

RICHARDSON, H. L. "What Fertilisers Could Do to Increase World Food Production," Adv Sci, XVII (January, 1961), 472-480.

World food production could be doubled by using fertilizers and other modern techniques.

ROSIN, Jacob. "Chemocracy, the Society of the Future," CEN, XXVIII (January 9, 1950), 97-98; 140.

Modern chemistry points the way toward utilization of natural resources and the creation of a world of practically absolute abundance.

RUSSELL, E. John. "Asia's Food Problems and Their Impact on the Western Countries," Int Aff, XXVI (July, 1950), 316-328.

Can Western science be effectively applied to increasing the agricultural output so that the growing population in Asia can be fed?

________. "Food Production for the Expanding World Population," Adv Sci, XVIII (January, 1962), 427-435.

Considers land use, application of modern technology, social factors in nutrition, and training of farmers and specialists.

RYDER, Norman B. and Charles F. WESTOFF. "Use of Oral Contraception in the United States, 1965," Science, CLIII (September 9, 1966), 1199-1205.

Oral contraception has become a major means of regulating fertility.

RYTHER, John H. "Potential Productivity of the Sea," Science, CXXX, (September 11, 1959), 602-608.

"Organic production by marine plankton algae is comparable to agricultural yields on land."

SAX, Karl. "Biological Resources as a Factor in International Understanding," Sci Mon, LXXII (May, 1951), 300-305.

"The population problem is the basic factor in the development and utilization of the world's biological resources."

SAZONOV, N. "Electricity in Agriculture," Impact, XII, No. 2 (1962), 135-141.

Use of electrical machines in agriculture and new applications of electricity.

SCRIMSHAW, Nevin S. "Food," Sci Am, CCIX (September, 1963), 73-80.

Discusses the ways in which science and technology can help solve the food problem.

SONNEBORN, Tracy M. "Implications of the New Genetics for Biology and Man," Bio Sci, XIII (April, 1963), 22-26.

Concludes that "there is no immediate prospect of radical new powers of controlling human heredity and evolution."

STAKMAN, E. C. "Science in the Service of Agriculture," Sci Mon, LXVIII (February, 1949), 75-83.

The service of science to agriculture and the importance of agriculture in the U.S.

4.7.3. MARINE SCIENCES

CORTESAO, Armando. "Nautical Science and the Geographical Revolution," Impact, IV (Summer, 1953), 111-118.

The greatest advances in nautical science were the discovery of nautical astronomy, the invention of Mercator's projection, and the invention of the marine chronometer.

DEACON, G.E.R. "The Use of Oceanography," Impact, IX, No. 2 (1958), 79-92.

Describes practical benefits from marine research and the UNESCO projects in this field.

HAMILTON, J.E. "Effect of Present-Day Whaling on the Stock of Whales," Nature, CLXI (June 12, 1948), 913-914.

Concludes that international regulations are not strict enough to prevent a reduction in the stock of whales.

ISAACS, John D. "Food from the Sea," IST, LXIV (April, 1967), 61-68.

More intelligent regulation of the fishing industry and incentives to inventiveness would help the industry to take advantage of U.S. fisheries research.

ISAACS, John D. and Walter R. SCHMITT. "Resources from the Sea," IST, No. 18 (June, 1963), 39-45.

Future resource prospects from the sea include new methods of fish cultivation for food, thermal energy, and mineral wealth.

KETCHUM, Bostwick H., ed. "Special Issue on Marine Biology," AIBS Bulletin, XIII (October, 1963), 22-70.

Includes 22 articles in the following categories: Introduction; National Agencies; Interest and Support; Research and Education; International Cooperation; Challenging Problems.

LAING, Mack. "Ungathered Harvests in the Ocean," Courier, XIX (September, 1966), 11-15.

The resources of the sea are least exploited by those nations which need them most because of lack of skills and capital.

MacDONALD, Gordon J.F. "What's in the Ocean?" IST, LXIV (April, 1967), 38-48.

The ocean's resources include minerals, food, and navigation routes.

MERO, John L. "Minerals on the Ocean Floor," Sci Am, CCIII (December, 1960), 64-72.

The ocean floor is strewn with nodules rich in manganese, copper, cobalt, and nickel, which might possibly be mined.

MERRIMAN, Daniel. "Food Shortages and the Sea," Yale Review, XXXIX (March, 1950), 430-444.

The resources of the sea and the problem of selecting points at which man can most advantageously break into the life cycle of the sea.

REVELLE, Roger. "Oceans, Science, and Men," Impact, XIV, No. 3 (1964), 145-178.

The science of oceanography and its applications.

SHOLOWITZ, Aaron L. "Safeguarding Our Seaways--the Modern Nautical Chart," Sci Mo, LXI (October, 1945), 249-264.

Developments from Ptolemy to Mercator, systematic surveying, hydrographic advances, scientific chart making, timeliness of charts, and aids to safe navigation.

SMITH, F. G. Walton. "What is There for Industry in Oceanography?" Res Man, IX (May, 1966), 193-200.

The training of "oceanographic engineers" capable of reaping the ocean's harvests will be the best long-run return from federal investment.

SPILHAUS, Athelstan. "Exploiting the Sea," Ind Res, VIII (March, 1966), 62-68.

Advocates Congressional support for oceanographic R & D based on analysis of potentially important resources of the sea and prospects for exploiting them.

4.7.4 ATMOSPHERIC SCIENCE AND WEATHER MODIFICATION

BATTAN, Louis J. "Changing the Weather," IST, No. 20 (August, 1963), 60-67.

Present knowledge about changing the weather includes only slight modifications; changing the climate is far in the future.

Environmental Science and Technology. "EROS - An Overview of the World We Live On," EST, I (June, 1967), 460-462.

The proposed Earth Resources Observation Satellite of the Department of the Interior.

GARRIOCK, W. S. "Long-Range Weather Research," Nature, CC (December 28, 1963), 1275-1276.

Methods of predictions by different meteorological services and the importance of international cooperation in meteorology.

HELLER, Austin N. and Samuel G. BOORAS. "Telemetered Air Quality Network Helps Chicago," EST, I (December, 1967), 984-990.

The air monitoring program in Chicago is described.

KIMBLE, George T. "The Changing Climate," Sci Am, CLXXXII (April, 1950), 48-53.

A questioning of the advisability of some man-made attempts to control the weather.

LANDSBERG, H. E. "Climate Made to Order," BAS, XVII (November, 1961), 370-374.

Possible modification of climates by engineering practices combined with climatological knowledge.

LALLY, Vincent E. and A. Brewster RICKEL. "Project GHOST," Sci Journal, III, No. 6 (June, 1967), 60-65.

Project GHOST (Global Horizontal Sounding Technique) is the cheapest and most effective method of keeping a world-wide watch on the weather.

LAN[illegible]BERG, H. E. "Storm of Balaklava and the Daily Weather Forecast," Sci Mon, LXIX (December, 1954), 347-352.

How the effect of the storm at Balaklava during the Crimean War brought the first governmental meteorological forecasting services into being.

MALONE, Thomas F. "Weather Modification: Implications of the New Horizons in Research," Science, CLVI (May 19, 1967), 897-901.

The scientific developments that are transforming weather and some of their implications that transcend science.

MASON, B. J. "Design and Evaluation of Large-scale Rain-making Experiments," Nature, CLXXV (March 12, 1955), 448-451.

MILLER, A. A. "The Use and Misuse of Climate Resources," Adv Sci, XIII (September, 1956), 56-66.

Methods of equalizing uneven distribution of the resources of rain, wind, and warmth of the sun, which could be wasted.

NEIBURGER, M. "Weather Modification and Smog," Science, CXXVI (October 4, 1957), 637-645.

In attacking the three main contributors to a Los Angeles-type smog, action on the sources emitting pollution is the most feasible.

NEIBURGER, Morris and Harry WEXLER. "Weather Satellites," Sci Am, CCV (July, 1961), 80-94.

Ways in which weather sattellites have affected the science of meteorology.

ROBERTS, Walter Orr. "Climate Control," Phys Today, XX (August, 1967), 30-36.

The place of the Global Atmosphere Research Program in furthering knowledge of atmosphere and climate.

SINGER, S. F. "Minimum Earth Satellites as 'Storm Patrol'," Sci Mon, CXXXV (August, 1957), 95-98.

Evaluation of artificial earth satellites for meteorological purposes.

WORKMAN, E. J. "The Problem of Weather Modification," Science, CXXXIII (October 19, 1962), 407-412.

The failure of attempts at rain-making and an argument for repeating the experiments.

4.7.5 WATER RESOURCES

ABU WAFA, Taher. "The Social and Economic Consequences of the High Aswan Dam," Impact, XIII, No. 4 (1963), 253-272.

A major step in controlling the water of the Nile for irrigation and power production.

American Political Science Review. "Government and Water Resources," APSR, XLIV (September, 1950), 575-649.

A symposium: Introduction by James W. FESLER; Congress and Water Resources by Arthur A. MAASS; National Executive Organization for Water Resources by Gilbert F. WHITE; The Valley Authority and Its Alternatives by Charles McKINLEY; and Water Resources and American Federalism by Albert LEPAWSKY.

BALCHIN, W.G.V. "Water Resources of the United States," Nature, CXCI (July 29, 1961), 444-446.

Reports by the Select Committee on National Water Resources with recommendations for use and control of resources.

DURISCH, Lawrence K. and Robert E. LOWRY. "State Watershed Policy and Administration in Tennessee," PAR, XV (Winter, 1955), 17-20.

A three-level government program for small watershed development.

Environmental Science and Technology. "The Federal Resources Research Program," EST, I (May, 1967), 400-403

The Committee on Water Resources Research coordinates all federal programs in this field with pollution control the area of major emphasis.

Environmental Science and Technology. "OWRR Covers the Waterfront," EST, I (May, 1967), 386-388.

The U. S. Office of Water Resources Research and its proposed Water Resources Scientific Information Center.

HOWE, Everett D. "The Demineralization of Water," Impact, XV, No. 3 (1965), 173-185.

Describes research into improving the quality of brackish water or obtaining fresh water from the sea.

JACKSON, C. J. "Water Supply and Demand," New Sci, IV (June 12, 1958), 150-152.

A national water policy is needed in Great Britain to deal with the problems of supply, pollution, and conservation.

LEOPOLD, Luna B. and Seymour TILSON. "The Water Resource," IST, No. 55 (July, 1966), 24-34.

Man has probably irreversibly disturbed the hydrological system, and pollution and distribution are the problems to face.

MANDEL, Samuel. "Underground Water," IST, No. 66 (June, 1967), 35-41.

Management of groundwater is essential to conserve the supply and insure its freshness. Practices in Israel described.

MAXWELL, John C. "Will There Be Enough Water?" Am Sci, LIII (March, 1965), 97-103.

Aspects of low and high cost water and such points as the ecological effect caused by the extraction of sea water.

NACE, Raymond L. "Water - Essential Factor of Economic Development," Impact, XIV, No. 1 (1964), 39-55.

Greater efficiency of use of water resources will be required as population and rate of industrialization grow.

PEARSALL, W. H. "Water Supply and Biology," Nature, CLX (August 9, 1947), 176-178.

Three aspects of water supply: purity; uniformity of quality; and volume required, and discussion of practices and progress in Britain.

PRICE, Reginald C. "Some Decisions in the State's Development of California's Waters during the 1960's," *PAR*, XXV (December, 1965), 290-296.

"Three instances of decision-making in a state water resource development agency."

REVELLE, Roger. "Mission to the Indus," *New Sci*, XVII (February 14, 1963), 340-342.

Plans for combatting waterlogging and salinity in West Pakistan.

________. "Water," *Sci Am*, CCIX (September, 1963), 93-108.

Development of water resources as a means of increasing agricultural or industrial production in the developing countries.

RICKLES, R. N. "The Water Crisis," *Ind Res*, VI, No. 9 (October, 1964), 38-45.

The need for more and better water can best be met by an interdisciplinary attack on utilization, renovation, and desalination.

SNIDER, Robert G. "The Work of the President's Water Resources Policy Commission," *Annals*, CCLXXXI (May, 1952), 155-162.

WADHAM, S. E. and D.M. MYERS. "The Snowy River Project (S.E. Australia)," *Nature*, CLXIV (September 10, 1949), 423-424.

Describes a river development scheme.

WHITE, Gilbert F. "Alternate Uses of Limited Water Supplies," *Impact*, X, No. 4 (1960), 243-263.

The application of research to determine the most efficient uses of water in arid zones and the social factors that influence use.

4.7.6 ENVIRONMENTAL POLLUTION

ALEXANDER, Martin. "Pollutants That Resist the Microbes," *New Sci*, XXXV (August 31, 1967), 439-440.

Some bio-chemical wastes cannot be broken down by microorganisms and may be forming harmful accumulations.

AUERBACH, C. "Biological Hazards of Nuclear and Other Radiations," Nature, CLXXVIII (September 1, 1956), 453-454.

Reviews official British and American reports.

_______. "Radioactive Fall-Out," Nature, CLXXXIII (June 27, 1959), 1773-1776.

Changing estimates of radioactive hazards and the overly-complacent government and public opinion.

BADGER, John. "The Pollution Fighters," Can Sci, I (Spring-Summer, 1967), 16-18.

The work of the Ontario Water Resources Commission.

BERANEK, Leo L. "Design for Acoustics," Phys Today, II (July, 1949), 19-22.

Noise problems of modern life call for long-range planning and research into building and city planning.

BUECHE, Arthur M. "Industry and the Pollution Problem," EST, I (January, 1967), 24-30.

Industry is both a cause and a victim of the pollution problem.

COCKROFT, John. "Radiological Hazards from Nuclear Explosions and Nuclear Power," Nature, CLXXV (May 21, 1955), 873-875.

A discussion of the intensity of radiation from nuclear explosions, genetic effects, and radiation from nuclear power development.

COHEN, G. "Atmospheric and Water Pollution: A Result of Industrial Development," Impact, X (No. 3, 1960), 166-186.

Since the beginning of industrial development man has been creating a new environment harmful to all life.

COTTAM, Clarence. "The Ecologists' Role in Problems of Pesticide Pollution," BioSci, XV (July, 1965), 457-463.

DIXON, Bernard. "Antibiotics on the Farm – Major Threat to Human Health," New Sci, XXXVI (October 5, 1967), 33-35.

Advocates action to control unrestricted rise of antibiotics in farming.

EGLER, Frank E. "Pesticides in Our Ectosystem," Am Sci, LII (March, 1964), 110-136.

An inquiry into the pertinent aspects of the sociological problems of pesticides in the human environment.

Environmental Science and Technology. "Air Pollution and the Ubiquitous Auto," EST, I (November, 1967), 878-880.

Air pollution and the recommendations of the Commerce Department's Panel on Electrically Powered Vehicles.

________. "Aquatic Life Water Quality Criteria," EST, I (November, 1967), 888-897.

Fourth report of the Aquatic Life Advisory Committee to the Ohio River Valley Sanitation Commission.

________. "The Continuing Tale of the Torrey Canyon," EST, I (May, 1967), 391-393.

The pollution problem caused by the wreck of a British oil tanker has led to the search for new legislation and new technology to prevent such episodes in the future.

________. "FWPCA: An Agency with a Mission," EST, I (September, 1967), 688-693.

Activities of the Federal Water Pollution Control Administration.

________. "Lake Erie: Dying But Not Dead," EST, I (March, 1967), 212-218.

The destructive effects of pollution in Lake Erie and some of the methods proposed to retard the natural aging process that has been so greatly accelerated by men's activity.

________. "Smog Signals," EST, I (January, 1967), 31-38.

Recent scientific and political conferences have studied air pollution and helped increase public awareness of the problem.

ERRERA, Maurice. "What Did the U.N. Radiation Committee Accomplish?" BAS, XIV (November, 1958), 388-393.

An account, evaluation, and prognostication.

ETTINGER, Morris B. and Donald I. MOUNT. "A Wild Fish Should be Safe to Eat," EST, I (March, 1967), 203-205.

Discusses "the interaction of drinking water standards, stream water quality standards, and food standards."

FARUR, M. Taghi. "What's Happening to Our Waters?" Sci Cit, IX (October, 1967), 191-195.

Report to the International Symposium on Eutroplication (water pollution).

FOZZY, Paula. "Atomic Waste Disposal," Ind Res, IV, No. 8 (September, 1962), 26-31.

The problems of radioactive waste disposal and possible solutions.

GAFFNEY, Mason. "Applying Economic Controls," BAS, XXI (June, 1965), 20-25.

Establishes criteria for national public air management for pollution purposes.

HAAGEN-SMIT, A.J. "The Control of Air Pollution," Sci Am, CCX (January, 1964), 24-31.

Los Angeles as an example of the causes and control of air pollution.

HILLABY, John. "People, Pesticides and Parliament," New Scientist, XXXIII (February 2, 1967), 264.

The use of pesticides in Britain and the need for stronger control by government to supplement the voluntary control measures taken by the manufacturers.

KNAGGS, Edward A. "The Detergent Dilemma," IST, No. 41 (May, 1965), 27-32.

Problems in handling a common pollutant.

KOHN, Robert E. "Air Pollution Control - For the Sixtieth Time," Sci Cit, IX (October, 1967), 195-197.

Report of the sixtieth annual meeting of the Air Pollution Control Association.

LANGFORD, G.B. "Whither Lake Erie?", Can Sci, I (Spring-Summer, 1967), 20-21.

Agricultural and industrial wastes dumped into Lake Erie are accelerating its natural life cycle and making its extinction inevitable.

McLEAN, Louis A. "Pesticides and the Environment," Bio Sci, XVII (September, 1967), 613-617.

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MARLEY, W. G. "Problems of Waste Disposal in the Wide-Scale Use of Radio-Isotopes," Impact, IX, No. 4 (1959), 231-243.

Nature. "Control of Radioactive Wastes," Nature, CLXXXV (January 23, 1960), 199-200.

Recommendations of a Radioactive Substances Bill in Britain which provides for a National Disposal Service for radioactive wastes.

PILPEL, Neiton. "Oil Pollution of the Sea," Sci Journal, III, No. 6 (June, 1967), 73-81.

The sporadic research undertaken since 1950 did not provide an adequate basis for tackling massive pollution in 1967.

PRINTZ, Albert C., Jr. "Impact of Water Quality Standards," EST, I (September, 1967), 694-697.

Despite the high cost of achieving adequate water pollution control, the public is beginning to realize its necessity.

SARGENT, Frederick, II. "Adaptive Strategy for Air Pollution," Bio Sci, XVII (October, 1967), 691-697.

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SOUTHGATE, B. A. "Synthetic Detergents and the Treatment of Water and Sewage," Nature, CLXXVIII (July 21, 1956), 118-119.

British and American investigations of the effects of detergents on sewage disposal and river water.

TAYLOR, Lauriston S. "Radiation Hazards in Realistic Perspective," Phys Today, XV (June, 1962), 32-40.

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TERRAL, Rufus. "To Kill a River," BAS, XX (September, 1964), 35-37.

The pollution of the Mississippi River and the consequent pollution of fish.

TILSON, Seymour. "Air Pollution," S+T (IST), No. 42 (June, 1965), 22-31.

Discusses technical, social, and political aspects of air pollution control, including the Clean Air Pact of 1963.

WILLIAMS, Hill. "Bikini Nine Years Later," Sci Journal, III, No. 4 (April, 1967), 48-53.

Life is recovering dramatically at this site of 59 nuclear tests.

WISE, William S. "Water Pollution Control," CEN, XXIX (December 3, 1951), 5120-5124.

The philosophy of pollution control, some of the difficulties involved, and the need for a coordinating agency.

WOLF, Leonard. "Cleaning up the Merrimack," BAS, XXI (April, 1965), 16-22.

Problems involved in combatting water pollution and the limitations of present efforts for river management.

4.8 BIOMEDICAL SCIENCE AND TECHNOLOGY

ALEXANDER, Leo. "Medical Science Under Dictatorship," NEJM, CCXLI (July 14, 1949), 39-47.

The abuses of medical science in Nazi Germany and the dangers of a utilitarian "rational" point of view in American medicine.

BARRON, E.S. Guzman. "The Nation's Medical Research," BAS, IV (February, 1948), 59-60.

Summarizes and comments on Vol. V of the Steelman Report on Science and Public Policy.

BERGER, F.M. "Computers and Medical Discoveries," PBM, XI (Autumn, 1967), 63-70.

Ways in which the computer could be of use in the discovery and development of new drugs.

BRESSLER, Marvin, ed. "Meeting Health Needs by Social Action," Annals, CCCXXXVII (September, 1961), (entire issue).

Fourteen articles on "the responsible exploration of the interrelationships between values and science in social medicine",

COMAR, Cyril L. "Biological Aspects of Nuclear Weapons," Am Sci, V (June, 1962), 339-353.

A view of biological radiation problems as they affect individuals and the making of public policy.

DONALDSON, R. J. "Production-line Medical Screening," New Sci, XXXVI (December 7, 1967), 587-589.

Describes a temporary screening clinic in Rotherham, England, which uses a production-line system and computerized records.

EIDUSON, Samuel. "The Biochemistry of Behavior," Sci Journal, III, No. 5 (May, 1967), 113-117.

The sociological impact of how the biochemistry of drugs will modify behavior.

EYSENCK, H. J. "Scientific Treatment of Criminals," *Sci Journal*, I, No. 1, (March, 1965), 47-52.

Conditioning criminals with a social conscience might be accomplished by drugs which aid such conditioning.

GRAY, George W. "The Rockefeller Foundation and the Biological Sciences," *AIBS Bulletin*, IV (January, 1954), 13-15.

HOLLAND, James F. "The Krebiozen Story," *JAMA*, CC (April 17, 1967), 213-218.

The facts of the Krebiozen promotion and methods for preventing future quackery.

HUXLEY, Julian S. "Eugenics in Evolutionary Perspective," *PBM*, VI (Winter, 1963), 155-187.

Describes eugenics as a necessary human science to promote human well-being.

(For an opposite point of view, see ROBERTS, Catherine, "Some Reflections on Positive Eugenics," *ibid.*, VII (Spring 1964), 297-307).

IVY, Andrew C. "Medical Research: Operation Humanity," *Sci Mo*, LXVIII (February, 1949), 118-121.

The benefits of medical research to humanity and the need for proper social control and use of its results.

LAPE, Esther Everett. "The American Foundation on Medical Research in Biological Perspective," *AIBS Bulletin*, VI (April, 1956), 9-12.

Projects of the American Foundation, especially its fifteen-year study published as *Medical Research: A Midcentury Survey*.

LEDERBERG, Joshua. "Molecular Biology, Eugenics and Euphenics," *Nature*, CXCVIII (May 4, 1963), 428-429.

The probable impact of biological knowledge on human affairs.

LOVVORN, Roy L. and Marguerite GILSTRAP. "Evolution of a Research Program on Weed Control," PAR, XIII (Winter, 1953), 33-37.

The reasons for, establishment of, and program purposes of a research bureau in federal-state weed research.

MILLIS, John S. "Challenges Ahead," JAMA, CLXXII (February 20, 1960), 819-821.

A review of the scientific activities of the American Medical Association.

NIMKOFF, Meyer F. "Biological Discoveries and the Future of the Family: A Reappraisal," Soc Forces, XLI (December, 1962), 121-127.

Progress in human biochemistry to support the view that biological discoveries have greater influence on the family than do technological developments.

PARRAN, Thomas. "Medical Services of the Future," Yale Rev, XXXV (March, 1946), 385-398.

Ways by which expanding biomedical sciences may be applied.

REYNOLDS, Orr E. "Space Bio-Sciences," Bio Sci, XII (October, 1962), 49-51.

ROBINSON, Julian Perry. "Chemical Warfare," Sci Journal, III, No. 4 (April, 1967), 33-40.

All aspects of chemical warfare as developed at the present time.

ROSENBLITH, Walter A. "Physics and Biology - Where do They Meet?" Phys Today, XIX (January, 1966), 23-34.

The physical sciences have much to contribute to health science and other fields of biology in the way of organization, technology, and management.

Scientist and Citizen. "Chemical and Biological Warfare," Sci Cit, IX (August-September, 1967), (entire issue).

Includes: Introduction by John T. EDSALL; Starvation as a Weapon: Herbicides in Vietnam I, by Jean MAYER; Changing the Environment: Herbicides in Vietnam II, by Arthur W. GALSTON; Chemical and Biological Warfare: History of International Control and U.S. Policy, by Robin ROMERO and Milton LEITENBERG; Chemical Weapons: What They Are and What They Do, by Victor W. SIDEL and Robert M. GOLDWYN; Gas in Yemen by Joseph SALVIA; Biological Weapons, by Milton LEITENBERG; Detection of Biological Weapons, by Virginia BRODINE.

SIMMONS, Leo W. "Important Sociological Issues and Implications of Scientific Activities in Medicine," JAMA, CLXXIII (May 14, 1966), 167-171.

The crosscurrents of change in the social order and in medical institutions and practice.

SIMPSON, George Gaylord. "Biology and the Public Good," Am Sci, LV (June, 1967), 161-175.

Theoretical and practical aspects of biology which affect the public good.

SMITH, John Maynard. "Eugenics and Utopia," Daedalus, XCIV (Spring, 1965), 487-505.

Several eugenic techniques and the extent to which they should be employed or are actually employed at present.

VISSCHER, Maurice B. "The Process of Medical Advance - In Retrospect and Prospect," JAMA, CXCIV (October 4, 1965), 38-44.

The history of progress in biomedical science and the requirements for advance today.

WEINBERG, Alvin M. "Scientific Choice and Biomedical Science," Minerva, IV (Autumn, 1965), 3-14.

The support of biomedical science on a large scale in the U.S. directly applies to the alleviation of disease.

WILSON, J. Walter. "Sciences of New Importance to Medicine," JAMA, CLXXXV (August 3, 1963), 386-391.

WOLFF, Heniz. "Technology and the Health Service," New Sci, XXXVI (December 7, 1967), 595-596.

Ways in which technology can be deployed to reduce costs in the Health Service of Great Britain.

4.9 LEARNING AND EDUCATIONAL TECHNOLOGY

ARMAND, Louis. "Machines, Technology and the Life of the Mind," *Impact*, III (Autumn, 1952), 155-170.

Man has adapted himself to scientific progress without loss to the life of the mind, but improved technology has created many thankless assembly-line jobs.

CARTER, Luther J. "Technology in the Schools: Educators are Uneasy," *Science*, CLIII (September 30, 1966), 1624-1626.

CHERRY, E. Colin. "The Communication of Information," *Am Sci*, XL, (October, 1952), 640-664; 724-725.

A historical review of mathematical information theory and cybernetics. Bibliography.

EVANS, Luther H. "The Challenge of Automation to Education," *ABS*, VI (November, 1962), 16-19.

The impacts of technology upon education and a prediction of a life-long formal learning process in store for the general population.

FINDLER, Nicholas. "Some Further Thoughts on the Controversy of Thinking Machines," *Cybernetica*, VI (No. 1, 1963), 47-52.

"The achievements of research in the field of artificial intelligence".

FINN, James D. "Take-Off to Revolution," *ABS*, VI (November, 1962), 12-15.

Some of the principal theories and findings of research in the growth and meaning of technology in education.

HERBERT, Evan. "Technology for Education," *S+T (IST)*, No. 68 (August, 1967), 28-49.

The applications of technology in education.

LEIBOVIC, K. N. "Learning Theory in Biological Systems and Machines," *Cybernetica*, V (No. 2, 1962), 116-134.

PIERCE, John R. "Communications, Technology and the Future," Daedalus, XCIV (Spring, 1965), 506-517.

Future uses of communications and transportation technology and their possible influence on social and individual welfare.

SKINNER, B. F. "Teaching Machines," Sci Am, CCV (November, 1961), 90-102.

A brief history of the machines, an explanation of the principles and procedures involved, and observations on the teacher's new role.

STECCHINI, Livio C. "Prospects in Retrospect: On Educational Technology," ABS, VI (November, 1962), 8-11.

Compares Roman "programmed" instruction with our own and the printing press with the teaching machine.

SECTION 5

SCIENCE, GOVERNMENT, AND PUBLIC INSTITUTIONS

Much of the literature dealing with public policy for science and technology relates to the actions of specific governments, or to such useful conceptual groupings as "developing nations" or "Western Europe." Section 5.1 includes articles which treat the interactions between science and government in a general context; it also includes articles which treat some of these interactions comparatively, such as studies of research and development expenditures, or of science advisory structures in the United States and the U.S.S.R. Sections 5.1.2 and 5.1.3 illustrate two broad categories under which general studies of the interactions between science and government are often considered: education, research, and economic development; and science and international relations. Additional materials relevant to these categories will be found in sections 5.2.10.1, 6.2, 9.1, and 9.3.

Science in the United States, section 5.2.1, includes materials which have been subcategorized according to the classifications indicated in the Table of Contents. The reader should note, however, that many of the other sections throughout the bibliography are, in fact, oriented toward United States problems and perspectives. This situation results naturally from the fact that most of the journals surveyed draw heavily upon American authors, and also from the fact that most items dealing with the identifiable policies, problems, or institutions of other nations have been entered under national headings.

With two additional exceptions, most topics dealing with specific nations or groupings of nations are to be found under the appropriate headings of section 5. The exceptions derive from the increasingly international and cooperative nature of science policy in such geographically linked areas as Western Europe, and from a similar linking of foreign affairs and technical assistance in the affairs of the developing nations. The science policy activities of Western European nations (5.2.5) are to be found under section 9.3.2 when those activities are cooperative rather than merely national. Similarly, additional materials relevant to the new and developing nations (5.2.10) may be found under sections 5.1.2, 5.1.3, 5.2.1.5, 9.2.2, 9.2.3, and 9.3.3.

5.1 SCIENCE AS AN OBJECT OF PUBLIC POLICY

5.1.1 GENERAL

APPLETON, Edward V. "Science, Government, and Industry," *CEN,* XXV (August 25, 1947), 2422-2426.

The consequences of the scientist's work must be interpreted to his fellow men and decisions on its use must be made by the community.

BRONK, Detlev W. "Research and National Policies," *CEN*, XXIX (January 22, 1951), 278-279.

Scientists' knowledge as defense against gambling with the nation's future.

CARTER, Charles Frederick. "Government and Technology," *Nature,* CCVI (May 15, 1965), 652-654.

Ways in which government can best assist and stimulate technological progress in so far as it would add to man's happiness.

COHEN, Felix. "The Role of Science in Government," *Sci Mon*, LXV (August, 1947), 155-164.

The problem of being scientific under the political control of scientific activities in the U.S.

DANIELS, George H. "The Pure-Science Ideal and Democratic Culture," *Science,* CLVI (June 30, 1967), 1699-1705.

A new scientific ideal in the late 19th century led to continuing conflicts with democratic assumptions.

DEDIJER, Stevan. "International Comparisons of Science," *New Sci*, XXI (February 20, 1964), 461-464.

Compares science policy in different countries.

DENNY, Brewster C. "Science and Public Policy: A Literature in Search of a Field," *PAR*, XXV (September, 1965), 239-248.

The need for more study by political scientists of the field of science and public policy. Reviews: *The Scientific Estate*, by Don K. PRICE; *The Moon-Doggle*, by Amitai ETZIONI; and *Ministers Talk About Science*, by Emmanuel G. MESTHENE, ed.

DUBARLE, D. "The Proper Public of Science: Reflections on a Cartesian Theme Concerning Humanity and the State as Audiences of the Scientific Community," Minerva, I (Summer, 1963), 405-427.

Descarte's thoughts on the relation of science to humanity and the impediment the modern state offers to the applications of science to universal human needs.

ENGSTROM, Elmer W. "Science, Technology, and Statesmanship," Am Sci, LV (March, 1967), 72-79.

Illustrates the need for statesmanship, education, and adequate communication to control and direct the rapid expansion of technology.

HOGG, Quintin McGarel (Lord HAILSHAM). "Science and Government in a Free Society," Nature, CXCII (November 4, 1961), 393-398.

Using Britain as an example, describes the role and organization of science and states that government should finance and coordinate, but not direct science.

JACKSON, Willis. "Second Parliamentary and Scientific Conference," Nature, CCIII (July 11, 1964), 118-119.

Reports on this conference, which was also supported by the Council of Europe and the Organization for Economic Cooperation and Development.

KELLY, Sheila. "The Social Sciences and the Policies of Governments," OECD Observer, Special Issue on Science (February, 1966), 38-42.

A first attempt at the international level to examine the problems of the development of social science research from the policy point of view.

KING, Alexander. "Fundamental Research and the Policies of Governments," OECD Observer, Special Issue on Science (February, 1966), 6-9.

Discusses reasons why governments should support fundamental research, problems of funding, organizations and environments conducive to high creativity, and proposals for the more rational use of the total resources of small countries.

________. "A Policy for Science," OECD Observer, No. 2 (January, 1963), 19-23.

The far-ranging impact of science on national policy has been recognized only gradually, and thus has been incorporated only piecemeal into the fabric of policy.

KING, Alexander. "Research and Political Power," Science, CXXVI (August 9, 1957), 237-238.

Research power and political strength are now mutually dependent.

________. "Towards a National Science Policy," Impact, XII (No. 3, 1962), 157-176.

Each country must implement a policy of cooperation between the state and the scientific community to meet social and economic needs.

KISTIAKOWSKY, George B. "National Policy for Science," CEN, XL (January 22, 1962), 120-124.

Belief that government must not sponsor research just for practical, political, or prestige results, but also for scientific results.

La PORTE, Todd R. "Diffusion and Discontinuity in Science, Technology and Public Affairs: Results of a Search in the Field," ABS, X (May, 1967), 23-29.

The startling discontinuity between the academic man and the decision-maker in the science policy area and an interpretive reaction to it.

________. "Politics and 'Inventing the Future': Perspectives in Science and Government," PAR, XXVII (June, 1967), 117-127.

The impact of science and technology on social change, political values, administrative organization, and the policy process.

LOW, Ian. "The Nations' Experiments in Science Policy," New Sci, XXIX (January 20, 1966), 164-165.

Reviews a report on Government and Allocation of Resources to Science by the Organization for Economic Cooperation and Development.

MASSEY, Harrie. "Evolution of a Policy for Science," New Sci, XXXII (November 24, 1966), 428-429.

Describes the trend of the past decade when governments set up bodies of experts to advise on science policy.

MATHER, Kirtley F. "The Common Ground of Science and Politics," Science, CXVII (February 20, 1953), 169-174.

The interdependence and similar objectives of science and politics are described.

MESTHENE, Emmanuel G. "Can Only Scientists Make Government Science Policy?" Science, CXLV (July 17, 1964), 237-240.

Scientists are not necessarily best fitted to deal with science policy.

________. "The Impacts of Science on Public Policy," PAR, XXVII (June, 1967), 97-104.

Science not only as a means of achieving goals, but as a "vehicle for redefining the ends themselves, modifying them, and making them more adequate to human purposes."

________. "Ministers Talk About Science," OECD Observer, No. 6 (October, 1963), 36-37.

The importance of formulating an explicit national science policy, and summary of the major themes to be discussed at the first international meeting on science at the ministerial level.

MOLLER, Werner. "National Research Councils and Science Policy," Impact, VI (September, 1955), 155-168.

Despite differences of structure, working methods, and ranges of influence in their respective countries, all councils have in common the aim to promote research.

MORRISON, Herbert. "Planned Research," Adv Sci, III (December, 1945), 296-308.

Followed by a discussion on the relationships between science and government.

New Scientist. "Science and Policy: A Paris Manifesto," New Sci, XIX (September 19, 1963), 599-601.

Summary of a report prepared for the Organization for Economic Cooperation and Development.

OPPENHEIMER, J. Robert. "Encouragement of Science," Science, CXI (April 14, 1950), 373-375.

Sees the link between science and politics as the symbiotic relationship between the scientific spirit and the free society.

Organization for Economic Cooperation and Development. "Governmental Policy for the Sciences: Ministerial Meeting at OECD," OECD Observer, No. 19 (December, 1965), 5-7.

A summary of problems of science policy discussed at the meeting.

Organization for Economic Cooperation and Development. "Progress in Science Policy," OECD Observer, No. 30 (October, 1967), 12-15.

Science policy as a determinative of a nation's power and future.

OSTROM, Vincent. "Knowledge, Science, and Policy," ABS, IV (January, 1961), 30-32.

The relationship between scientific method and policy-making.

PARR, J. Gordon. "Science in Politics," Can Sci, I (Spring-Summer, 1967), 8-9; 21-23.

Government support of pure and applied science would be more justified if the politically disinterested scientist and the scientifically ignorant politician cooperated in analyzing the basic effects of science on man's present and future.

POLANYI, Michael. "The Planning of Science," Pol Q, XVI (October-December, 1945), 316-328.

Describes pure and applied science, showing that the former cannot generally be subjected to planning.

PRICE, Derek J. De Solla. "Nations Can Publish or Perish," S+T (IST), LXX (October, 1967), 84-90.

Published scientific papers provide a model for comparing the science programs of different nations as to scope, investment of resources, and effectiveness.

________. "The Scientific Foundations of Science Policy," Nature, CCVI (April 17, 1965), 233-238.

Shows the value to an efficient science policy of understanding why science works as it does and how it interacts with society.

PRICE, Don K. "Organization of Science Here and Abroad," Science, CXXIX (March 20, 1959), 759-765.

The status and influence of the science adviser in the federal government, with comments on the role of his British counterpart.

SALOMON, Jean-Jacques. "Progress in Science Policy," OECD Observer, No. 30 (October, 1967), 12-15.

Seminar discussions of science and public policy and the economy, fundamental and applied research and development, allocation of resources, and international scientific relations.

SNOW, C. P. (Lord SNOW). "Government, Science, and Public Policy," Science, CLI (February 11, 1966), 650-653.

The challenge of whether the world can survive half rich and half poor.

TABOR, David. "Science and Research: Problems of Small States," Phys Today, XVI (August, 1963), 38-42.

Is the pattern of research in large and affluent countries suitable for small nations?

WIMPERIS, H.E. "Atomic Energy Control: The Present Position," Int Aff, XXIV (October, 1948), 515-523.

The failure to achieve international control of atomic energy and future plans, such as a Western defensive alliance.

ZUCKERMAN, Solly. "The Limitations of Advisers," Nature, CCXIV (April 22, 1967), 341-342.

Extracts from an address to the Science of Science Foundation on the subject of scientific advisory bodies.

5.1.2 EDUCATION, RESEARCH, AND ECONOMIC DEVELOPMENT

ALLISON, David. "The University and Regional Prosperity," S+T (IST), No. 40 (April, 1965), 22-31.

The connection between strong schools of science and engineering and regional development.

BARNETT, Harold J. "Research and Development, Economic Growth, and National Security," Annals, CCCXXVII (January, 1960), 36-49.

The effects of research and development upon the national economy and considerations for government policy concerning R & D.

BLACKETT, P.M.S. "The Ever Widening Gap," Science, CLV (February 24, 1967), 959-964.

Aspects of why the poor countries of the world are getting less poor very much more slowly than the rich countries are getting richer; the role of science and technology; and problems of population and industrialization.

BOWDEN, Bertram Vivian (Lord BOWDEN). "To the Limits of Growth," New Sci, XXVII(September 30, 1965), 849-853.

Scientific activity and expenditure cannot continue to grow indefinitely and policies may have to be changed drastically when a slowdown comes.

BRIGGS, Asa. "Technology and Economic Development," Sci Am, CCIX (September, 1963), 52-61.

History of development and factors creating "rich" and "poor" nations.

CAINE, Sydney. "Education for Development," Adv Sci, XIV (December, 1957), 191-200.

General education for all necessary for the developing countries.

CARTER, Anne P. "The Economics of Technological Change," Sci Am, CCXIV (April, 1966), 25-31.

"Input-output tables listing the transactions among all sectors of industry in the U.S. for the years 1947 and 1958."

CARTER, Charles Frederick. "The Distribution of Scientific Effort," Minerva, I (Winter, 1963), 172-181.

A British view, proposing "an assessment of the economic requirements for science and technology in relation to the most serious limiting factor of the economy concerned" as a basis for the distribution of effort.

CHASTAIN, Clark E. "Science, Technology and Economic Growth," Impact, XIV (No. 4, 1964), 239-248.

Discusses relationship of science and technology to economic growth.

DANILOV, Victor J. "Build It Here," Ind Res, V, No. 5 (May, 1963), 17-22.

Site selection of industrial research laboratories has become a complex affair involving very special studies.

DANILOV, Victor J. "How Successful Are Science Parks?" Ind Res, IX (May, 1967), 76-81.

Since 1951 about 125 science parks have been created in the U.S. and Canada, but about half must be adjudged failures.

________. "The Seduction of Science," Ind Res, VII, No. 5 (May, 1965), 38-50.

The best investment of state funds is to develop one or more universities distinguished in science and industry.

________. "Sites for Sale," Ind Res, VI, No. 5 (May, 1964), 30-37.

Communities in which R & D industries are located benefit greatly from this industry, and there is fierce competition to attract them.

DEDIJER, Stevan. "Measuring the Growth of Science," Science, CXXXVIII (November 16, 1962), 781-788.

Three uses of the measurement of the growth of science.

DEUTCH, Michael J. "Can We Afford Atomic Power for Underdeveloped Countries?" BAS, XVI (January, 1960), 23-27.

The cost of atomic energy is still too high for its general distribution.

FREEMAN, Christopher. "The Evaluation of Science," New Sci, XXX (June 9, 1966), 660-662.

The relationships among expenditures on basic research, applied research, and national economic growth.

FRIEDWALD, E.M. "The Research Effort of Western Europe, the USA and the USSR " OECD Observer, Special Issue on Science (February, 1966), 10-15.

Report of a study of "three great areas which are comparable in population and resources and which constitute the main centers of scientific activity in the world."

GASS, J.R. "The Allocation of Resources to Science," OECD Observer, Special Issue on Science (February, 1966), 33-37.

Governmental planning of scientific activities must be channelized and planned for.

HARBISON, Frederick. "Education for Development," Sci Am, CCIX (September, 1963), 140-147.

Four countries in different stages of development are using education to build up their human capital.

HOLLOMON, J. Herbert. "Science, Technology, and Economic Growth," Phys Today, XVI (March, 1963), 38-46.

The relationship between science and economic growth in the U.S. and steps for strengthening economic health by the proper support of science.

________. "Technology and Economic Growth," Res Man, VI (May, 1963), 185-195.

The community of interest between government and industry and new national policies to insure effective use of technology in industry.

KING, Alexander. "Education and Change," Nature, CCVI (June 12, 1965), 1078-1083.

The demands placed on education by constant economic, social and technological changes.

KOVDA, Victor A. "Index of Prosperity: S.T.P." Courier, XVI (July-August, 1963), 19-23.

Factors in a country's S.T.P. (scientific and technical potential), and the usefulness of UNESCO's assistance in planning national scientific policy.

LECERF, D. "Major Research and Development Programmes as Instruments of Economic Strategy," Impact, XVII (No. 2, 1967), 115-134.

"Major programmes" administered by national or international authority, as valuable instruments of industrial strategy for both underdeveloped and wealthy nations.

LOFTUS, Joseph E. "Some Observations on the Economics of Atomic Power," Sci Mon, LXX (June, 1950), 396.

The development, costs, and political implications of the distribution of atomic fuel in the event of widespread use of atomic power.

LOW, Ian. "The R & D Race," New Sci, XXVIII (December 16, 1965), 817-818.

Survey of research and development effort in Western Europe, North America, and the Soviet Union.

Minerva. "Science, Economic Growth and Government Policy," *Minerva,* II (Winter, 1964), 232-242.

Background paper for the OECD Ministerial Meeting on Science held in Paris, October 3-4, 1963.

Organization for Economic Cooperation and Development. "Adapting the Training of Engineers to the Requirements of Economic Growth," *OECD Observer,* No. 26 (February, 1967), 12-14.

"There is a danger that economic growth will be hindered by the fact that engineers leaving college are rarely capable of exploiting the full potential offered by computers, which call for specialized mathematical knowledge."

________. "Relating Science and Technology to Economic Development," *OECD Observer,* No. 15 (April, 1965), 8-11.

Report of an experimental attempt to link scientific and technical research policies in a number of OECD member countries with development objectives.

________. "The Relationship Between Science and Economic Growth," *OECD Observer,* No. 7 (December, 1963), 14-18.

Conclusions about this relationship and about the complementary roles of government and industry in funding research and development.

________. "Resources Devoted to Research and Development in OECD Member Countries," *OECD Observer,* No. 30 (October, 1967), 32-37.

Absolute and relative comparisons of resource allotments in money and manpower.

ORLANS, Harold. "Some Current Problems of Government Science Policy: What Should Be the Balance Between Expenditures on Pure and Applied Sciences and Who Should Set It?" *Science,* CXLIX (July 2, 1965), 37-40.

Inconsistencies in current pattern of government support and questions about returns in certain fields of research being commensurate with, or greater than, the cost.

ROBBINS, Lionel Charles (Lord ROBBINS). "Technology and Economics and their Relation to Public Policy," *Nature,* CC (November 16, 1963), 621-623.

Technology, its relations with economics, their joint status in regard to public policy, and the use of skills and knowledge they involve in the conduct of public business.

SLICHTER, Sumner H. "Some Economic Consequences of Science," Annals, CCXLIX (January, 1947), 99-110.

The problem-creating effects of science need to be balanced by its problem-solving effects.

SMITH, Ewart. "The Critical Importance of Higher Technological Education in Relation to Productivity," Adv Sci, VII (December, 1950), 297-307.

Compares industrial productivity and technological education of Britain and the U.S.

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RAISON, Timothy. "Research in the C.A.T.'s," New Sci, XI (July 6, 1961), 18-19.

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RELF, E. F. "College of Aeronautics," Nature, CLVIII (August 17, 1946), 225-226.

A new British institution for postgraduate training.

ROSE, Steven. "Forecasting the Impact of Science," New Sci, XXXII (November 10, 1966), 288.

The inaugural seminar of the Science Studies Unit at the University of Edinburgh.

SMITH, R. A. "The University and the Research Institute," Nature, CCII (May 9, 1964), 529-530.

Suggests that Britain follow the U.S. example of setting up research institutes closely associated with universities.

TEMPERLEY, H.N.V. "Graduate Students in Britain," Science, CXXIV (August 24, 1956), 355-356.

Describes the basic differences between British and American graduate students and presents the British study program.

TOBIAS, S. A. "Engineering and Education," Sci Journal, I, No. 9 (November, 1965), 80-85.

An interview with S. A. TOBIAS, Professor of Mechanical Engineering at Birmingham University, about the roles of the engineer and the problems of educating persons to fill these roles.

WILLIAMS, Trevor I. "Provincial Universities in the United Kingdom," Science, CXXIV (August 24, 1956), 347-350.

Twelve provincial universities in England offer opportunities in science and technology.

5.2.2.3. SCIENCE SOCIETIES

ANDRADE, E. N. da C. "The Royal Society Today," New Sci, VII (July 14, 1960), 111-113.

The work and influence of Britain's leading scientific society.

ANDRADE, E. N. da C. and D. C. MARTIN. "The Royal Society and Its Foreign Relations," Endeavour, XIX (April, 1960), 72-80.

History of the Society's international relations in its three hundred years.

CALDER, Nigel. "The B. A. and the Interpretation of Science," New Sci, VIII (September 1, 1960), 562-563.

The value of the British Association for the Advancement of Science as an interpreter of science to the public.

CALDER, Ritchie. "Science and Life," Science, CVIII (September 3, 1948), 247-248.

The history, philosophy, and present concerns of the British Association for the Advancement of Science.

FLOREY, Howard, (Lord FLOREY). "The Future of the Royal Society," *New Sci*, XXIV (December 3, 1964), 638-640.

The President of the Royal Society proposes including more applied scientists in its membership and considers the relation of the Society to government.

_______. "The Royal Society: Anniversary Address," *Nature*, CCVIII (December 18, 1965), 1141-1145.

The President of the Royal Society proposes fields in which the Society might encourage research, such as oceanography, population and environment, and international cooperation of all kinds.

GIBSON, C. S. "The Chemical Society (of London) After One Hundred Years," *Endeavour*, VI (April, 1947), 63-68.

HARTLEY, Harold. "The Tercentenary of the Royal Society," *Am Sci*, XLVIII (September, 1960), 279-299.

History of the founding and subsequent importance of the Royal Society, with pictures of historical interest.

HAYS, J. N. "Science and Brougham's Society," *Ann Sci*, XX (September, 1964), 227-241.

The Society for the Diffusion of Useful Knowledge, which existed in England from 1826 to 1846, and its work.

HINDLE, Edward. "The Ass that Plodded from Ridicule to Renown," (September 5, 1957), 15-18.

History and activities of the Brit

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LANGE, Erwin F. and Ray F. BUYERS. "Medals of the Royal Society of London," Sci Mon, LXXXI (August, 1955), 85-90.

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MARTIN, D. C. "The Tercentenary of the Royal Society," Science, CXXXI (June 17, 1960), 1785-1790.

A brief historical account of the oldest learned society with a description of its current activities, public duties, and international relations.

MATTHEWS, L. Harrison. "The Zoological Society of London," Endeavour, XII (January, 1953), 18-24.

Describes scientific activities of the Society and the zoo itself.

ORIEL, John. "Too Many Learned Societies?" New Sci, VII (April 7, 1960), 854-856.

Suggests avoiding the proliferation of learned societies, especially those relating to science and technology in Britain.

PEIERLS, R. E. "The British Atomic Scientists' Association," BAS, VI (February, 1949), 59.

Describes the Association's membership, policy, and activities.

PHILIP, Duke of Edinburgh. "The British Association for the Advancement of Science," Adv Sci, XV (March, 1959), 309-314.

An address to the Indian Science Congress describing the history and functions of the British Association.

THORNTON, Gerard. "Overseas Activities of the Royal Society," New Sci, VII (July 14, 1960), 118-120.

Past and present international activities.

THRING, M. W. "Do British Engineers Need an Academy?" Nature, CCXIV (June 17, 1967), 1186-1187.

The creation of a National Academy of Engineering in the U.S. strengthens the view that such an academy would be desirable in Britain.

5.2.2.4. SCIENTIFIC MANPOWER

BOWDEN, Bertram Vivian, (Lord BOWDEN). "The Migrant Scientist," New Sci, XXI (March 5, 1964), 594-596.

The employment of foreign scientists in such advanced countries as England and the U.S. is at the expense of the development of their own countries.

BRUNDRETT, Frederick. "The Shortage of Recruits for the Scientific Civil Service," New Sci, VIII (September 29, 1960), 842-844.

A British Civil Service commissioner discusses personnel shortages.

CARTER, Charles Frederick. "How Britain Can Get More Scientists," New Sci, III (December 5, 1957), 14-15.

Suggests changes in the educational system, encouragement of women to take up science, and better use of present personnel.

DAVIES, D. S. and M. C. McCARTHY. "Education for Change," Nature, CCXIV (June 10, 1967), 1079-1081.

Britain's prospective scientific manpower needs and suggestions for increasing the supply of personnel.

DOUGLASS, William Angus. "How to Stop the Brain Drain," New Sci, XXXIV (April 6, 1967), 39-41.

The managing director of Careers incorporated, which recruits British technologists for work in the U.S., makes suggestions for utilizing more of their talent in Britain.

FELLS, Ian. "Making the Best of Britain's Science Talent," New Sci, XXIX (March 31, 1966), 858.

Better recruiting procedures by means of coordination between industry and the universities.

HATCH, Stephen. "Why Scientists Leave Britain," New Sci, XXXIV (April 13, 1967), 98-100.

A survey of the numbers of emigrants, their qualifications, and their reasons for leaving Britain.

HATCH, Stephen and Ernest RUDD. "Emigrants and Homecomers," New Sci, XXVIII (November 18, 1965), 527-528.

Concludes that the "brain drain" of British scientists is not as serious as it seems because most of the emigrants return.

HOLLOWAY, B. J. "The Threat of Manpower Starvation," New Sci, XXIV (November 12, 1964), 435-437.

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JACKSON, Willis. "Manpower Resources for Science and Technology," Sci Journal, II, No. 11 (November, 1966), 80-85.

The 1965 British Manpower Report shows that soon the demand for scientists and engineers will outstrip the supply.

JEWKES, John. "How Much Science?" Adv Sci, XVI (September, 1959), 67-80.

An economist questions the claimed shortage of scientists in Britain.

JOHNSTONE, R. Edgeworth. "From Practice to Theory and Back," Nature, CCXIII (March 25, 1967), 1177-1179.

Discusses engineering education in Britain and whether it puts enough emphasis on practical problems.

LOW, Ian. "The Land They Leave," New Sci, XXXIV (May 18, 1967), 404.

Report from the British Association of Science Workers symposium at which speakers from Britain, India, and Ceylon discussed the "brain drain" of their scientists and policies to cope with it.

McCRENSKY, Edward. "Scientists in the British Civil Service," Science, CXXIV (August 24, 1956), 567-571.

Personnel policies applied to scientists in the British Civil Service.

Nature. "Professional Engineers in Britain," Nature, CLXXXV (January 2, 1960), 5-80.

Review of an address by Willis JACKSON, which deals mainly with education.

New Scientist. "The Brain Drain--Two Points of View," New Sci, XXXII (December 1, 1966), 502-503.

Two views of the migration of British scientist and engineers to the United States. Includes: Little Britain in the West, by Richard RUSHTON; and Making Sure there's No Place Like Home, by Alastair GEBBIE and Katherine GEBBIE.

PHILLIPS, Jean. "Women in Science," Sci Journal, II, No. 5 (May, 1966), 77-81.

A discussion of opportunities for women in science and technology and the reasons for the small number of women scientists and engineers.

RAISON, Timothy. "Britain's Emigrant Scientists," New Sci, VII (July 28, 1960), 278-280.

The numbers of British scientists who emigrate to North America and the steps being taken to reduce this emigration.

________. "Too Many Scientists--or Too Few?" New Sci, VI (December 17, 1959), 1258-1260.

Supports the view that Britain needs to increase its output of scientists and engineers. (See also idem., "A Surplus of Scientists?", New Sci, XII (October 19, 1961), 181-183, which questions a report that predicts a surplus of scientific manpower in Britain.)

SUTHERLAND, Gordon. "The Brain Drain," Pol Q, XXXVIII (January-March, 1967), 51-61.

Analyzes the emigration of British scientists and engineers to the U.S. and suggests that international measures of control be adopted to check this process.

WILSON, James A. "The Emigration of British Scientists," Minerva, V (Autumn, 1966), 20-29.

Results of a U.S. survey to find out which British scientists had emigrated, and why; their positions and kind of work in North America; and their feelings about having emigrated and their future intentions.

ZUCKERMAN, Solly. "Progress towards Doubling Our Scientific Manpower," New Sci, III (April 3, 1958), 8-9.

Discusses the British campaign to produce more scientists and technicians.

5.2.2.5. ATOMIC ENERGY

Bulletin of the Atomic Scientists. "The British Program of Nuclear Power," BAS, XI (June, 1955), 224-225.

Summary [illegible] a White Paper presenting a plan for producing a substantial portion of Britain's electricity from nuclear power by 1965.

COCKCROFT, [illegible]ohn. "Retrospect," Nature, CCXV (September 16, 1967), 1228-1229.

A review of Britain's atomic energy program since 1948.

GIBB, Claude. "Recent Industrial Development in Nuclear Power," New Sci, IV (July 17, 1958), 410-411.

British industry has been quick to apply the results of scientific advances in developing nuclear power stations. (See also CALDER, Nigel, "How They Are Building Nuclear Britain," ibid., IV July 17, 1958, 413-418.)

HAMILTON, David. "Nuclear Power Goal," New Sci, XXXIV (June 8, 1967), 583.

Britain's nuclear power stations have failed to provide cheap electricity and have not been able to compete with American plants on the export market.

________. "Slimming the Nuclear Enterprise," New Sci, XXXVI (October 19, 1967), 173.

Britain's nuclear industry is being studied by a Select Committee on Science and Technology which may recommend improvements in organization.

HAWKES, Nigel. "Recipe for Nuclear Power," Nature, CCXVI (December 2, 1967), 854-855.

Proposals for reorganizing Britain's nuclear power program.

HINTON, Christopher. "Atomic Energy Developments in Great Britain," BAS, IX (December, 1953), 366-368; 390.

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________. "Atomic Power in Britain," Sci Am, CXCVII (March, 1958), 29-35.

A report on Britain's application of atomic energy for peaceful pursuits.

HODGSON, P. E. "Atomic Scientists and the Public," New Sci, VI (August 6, 1959), 156-157.

Reviews accomplishments of the Atomic Scientists' Association in Britain.

JUKES, J. A. "Nuclear Energy: A Survey of Britain's Position," Int Aff, XXXII (July, 1956), 273-282.

Describes Britain's military and civil nuclear energy programs and their economic and political effects.

MATTERSON, A.H.S. "The Atomic Energy Research Establishment: The First Ten Years," Nature, CLXXVII (June 30, 1956), 1195-1196.

Describes the work at Harwell, England.

Nature. "The National Institute for Research in Nuclear Science," Nature, CLXXIX (May 23, 1957), 1043-1048.

The comments of leading scientists concerning this new institute in Britain.

NELSON, George. "British Nuclear Engineering: The Next Ten Years," New Sci, VIII (October 27, 1960), 1115-1117.

The history of Britain's atomic power program and suggestions for its future course.

ROTHERHAM, L. and A. B. McINTOSH. "Applied Research and Development Within the Industrial Group of the U.K. Atomic Energy Authority," Nature, CLXXVIII (September 8, 1956), 524-527.

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SPENCE, R. "Twenty-one Years at Harwell," Nature, CCXIV (April 22, 1967), 343-344; 436-438.

A history of the U.K. Atomic Energy Research Establishment at Harwell, England.

WATSON, Christopher J. H. "Myopia Among the Power Men," New Sci, XXXVI (November 23, 1967), 476-477.

Britain's fuel policy and the need for further development of the nuclear-power industry.

WOOLF, Leonard. "Britain in the Atomic Age," Pol Q, XVII (January-March, 1946), 12-24.

Problems of atomic energy control and disarmament and also the question of sharing atomic secrets with the U.S.S.R.

5.2.2.6. INDUSTRY AND TECHNOLOGY

BLACKETT, P.M.S. "Blackett on British Technology," Nature, CCXII (February 25, 1967), 755.

Extract from an address criticizing the industrial structure, government procurement, and the organization of research and development.

________. "Role of the Technologist in the Modern World," Nature, CCXII (December 3, 1966), 975.

"Views on the problems of the place of engineers and technologists in contemporary British life and the relations of the Royal Society to technology and engineering."

CHRISTOPHERSON, D. G. "The Exploitation of Research," Adv Sci, XIX (November, 1962), 273-280.

British industry should be more ready to exploit the discoveries of British scientists.

CLARKE, Richard. "Organization of Ministry of Technology," Nature, CCXVI (November 25, 1967), 745-746.

Describes a newly-formed British government department.

FISHLOCK, David. "Blueprint for British Technology?" New Sci, XXXII (December 1, 1966), 515-517.

Suggestions for research and development to be carried out under a new Minister of Technology in Britain.

________. "The 'Fall-Out' Fallacy," New Sci, XXV (January 21, 1965), 149.

Suggestions for extracting more civil benefit from Britain's major national technological projects.

FLEMING, Arthur P.M. "Bridging the Gap Between Science and Industry," Adv Sci, VI (October, 1949), 244-248.

The costs of fundamental research and the shortage of personnel call for greater cooperation between government and industry in Britain.

GIFFARD, J.A.H., (Earl of HALSBURY). "The Outlook for Industry," New Sci, I (February 14, 1957), 16-18.

The Director of the National Research Development Corporation makes suggestions for the deployment of Britain's technological resources.

GOODEVE, Charles. "A'Route 128' for Britain?" New Sci, XXXIII (February 9, 1967), 346-348.

Collaboration between the Massachusetts Institute of Technology and nearby industry could be a model for strengthening research and development in Britain.

HARTLEY, Harold. "Problems and Prospects in Industry: A Survey," New Sci, I (December 20, 1956), 10-13.

The impact of research, factors that limit progress, future prospects, and lessons for Britain.

HARVEY, Hugh. "Milstead Laboratory of Chemical Enzymology,'Shell' Research, Ltd.," Nature, CXCIX (August 3, 1963), 427-428.

Describes the organization of this new laboratory, which will be concerned mainly with investigations of enzymes.

HUGHES, Thomas Parke. "British Electrical Industry Lag: 1882-1888," Tech Cult, III (Winter, 1962), 27-44.

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McELHENY, Victor K. "Bolder Policies for British Technology?" Science, CLII (May 6, 1966), 741-744.

MELVILLE, Harry. "Industrial Research and Productivity," New Sci, XVI (November 15, 1962), 367-368.

The contribution of industrial research in Britain, with special reference to the role of government.

MENZIES, A. C. "Why Are Some Firms Technically Backward?" New Sci, II (May 30, 1957), 9-10.

Reviews on investigation into the application of science in British industry.

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Summary of a report by the Federation of British Industries. (See also ibid., "Pattern of Research in British Industry," 232-240, in which the distribution of research effort and the obstacles to research and development efforts in small firms are discussed.)

Nature. "The Short History of the Ministry of Technology," Nature, CCXI (July 9, 1966), 115.

The research stations and other functions of this new British ministry.

ROBERTSON, Andrew. "Technological Change, Management and Labour," Pol Q, XXXV (April-June, 1964), 171-181.

The need for national planning in Britain to meet the challenge of technological change with the interests of both labor and management in view.

VALÉRY, Nicholas. "A Policy for Ocean Industry," Sci Journal, III, No. 12 (December, 1967), 74-84.

Calls for revising the organization and administration of the British system of allocating funds for oceanography.

WOODWARD, F. Neville. "Development of Science-Based Industry in Scotland," Res Man, VI (January, 1963), 39-46.

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5.2.2.7. SCIENCE MUSEUMS, INSTITUTES, AND RESEARCH CENTERS

BRAGG, W. L. "A Center of Fundamental Research," Phys Today, VI (January, 1953), 18-19.

The research program of the Cavendish Laboratory at Cambridge University.

BRAMBELL, F.W.R. "The Wellcome Laboratory of Experimental Embryology, University College of North Wales, Bangor," Nature, CXCVIII (April 13, 1963), 141.

Facilities, staff composition, and research provisions for work which will primarily concern mammalian development.

CHICK, Harriette. "The Lister Institute of Preventive Medicine," Endeavour, VIII (July, 1949), 106-111.

CHINNECK, A. "The National Physical Laboratory," Nature, CCIII (August 8, 1964), 579-582.

The latest work and facilities of the laboratory.

COLE, Harvey. "A Hundred Years of Natural History Studies," New Sci, IV (June 5, 1958), 121-122.

History and present activities of the London Natural History Society.

COOPER, L.H.N. "Research in Oceanography," Nature, CLXVIII (August 4, 1951), 184-185.

The new National Institute of Oceanography in Britain and the progress of research.

CRAGG, J.B. "The Nature Conservancy's First Ten Years," New Sci, V (March 26, 1959), 683-685.

Work of the British agency for the conservation, research, and management of nature reserves.

Great Britain. Department of Scientific and Industrial Research. "The Chemical Research Laboratory," Science, CXIII (March 9, 1951), 261-263.

The history, location, facilities, functions and directors of the laboratory.

HARVEY, L. A. "Nature Conservation in Britain," Nature, CLXXIII (March 20, 1954), 516-517.

Reviews of the annual reports of the Nature Conservancy.

HOGG, Quintin McGarel, (Lord HAILSHAM). "The Laboratory of the Government Chemist," Nature, CCII (May 23, 1964), 742-743.

Brief summary of the activities of the laboratory in London and at outstations.

HUBBARD, C. E. "Bicentenary of the Royal Botanic Gardens, Kew," *Endeavour*, XVIII (July, 1959), 156-160.

Past and present functions include the introduction of new plants of economic value to countries of the Commonwealth, preparation of floras and indices, and research and practival training.

HUMPHRIES, E. C. "The John Innes Institute," *Nature*, CCIV (October 17, 1964), 232.

The Institute's 1963 activities in genetic and agricultural research.

JEPHCOTT, Harry. '"The Warren Spring Laboratory: An Experiment in Versatility," *New Sci*, VI (July 2, 1959), 15-16.

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JONES, Harold Spencer. "The Royal Observatory, Greenwich," *Endeavour*, VII (January, 1948), 9-14.

History of "the oldest scientific institution in Great Britain; founded in 1675 as a site for making observations to assist navigation."

MELLANBY, Kenneth. "Monks Wood Experimental Station," *Nature*, CC (November 20, 1963), 825-826

The lay-out and functions of this new station of the Nature Conservancy in Britain.

Nature. "The Fisheries Biochemical Research Unit," *Nature*, CXCVII (February 27, 1963), 754-755.

The facilities of the unit sponsored by the United Kingdom Development Commission.

________. "The International Research and Development Co., Ltd.," *Nature*, CXCVII (February 9, 1963), 529-533.

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________. "New British Electron Accelerator," *Nature*, CCXIV (June 17, 1967), 1183-1185.

The NINA electron accelerator at the Daresbury Nuclear Physics Laboratory.

SALISBURY, Edward. "The Royal Botanic Gardens, Kew," *Endeavour*, VI (April, 1947), 58-62.

Description and photographs of Britain's famous botanical center.

SEALY, J. R. "Royal Botanic Gardens at Kew," *Science*, CXXIX (May 22, 1959), 1403-1407.

Brief account of the history and research functions written to commemorate the bicentenary of Kew Gardens.

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A description of the British national museum of science and industry.

TUBBS, F. R. "The East Malling Research Station (1913-63)," *Nature*, CXVIII (April 27, 1963), 327-331.

An account of the developing trends of research at the station, the purpose of which is "the study of problems which are met with in the actual culture or growth of fruit trees and bushes."

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WEINTROUB, S. "The National Physical Laboratory, Teddington," *Nature*, CCVI (May 8, 1965), 565-566.

Reports on recent publications by the National Physical Laboratory.

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Complete reports on the Centre at East Kilbride.

WOOD, Alexander. "History of the Cavendish Laboratory, Cambridge," *Endeavour*, IV (October, 1945), 131-135.

5.2.3 CANADA

BADGER, John. "For Whom Could the Bell Toll?" Can Sci, I (Spring-Summer, 1967), 10-11.

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BALLARD, B. G. "Organization of Scientific Activities in Canada," Science, CXXIX (March 20, 1958), 754-759.

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BLANCHARD, J. E. "The Nova Scotia Research Foundation," Can Sci, I (Fall, 1967), 26-27.

The work and expansion of this Foundation established to foster applied and industrial research in Nova Scotia.

GRACE, Norman S. "The Management of Industrial Research in Canada," Can Sci, I (Spring-Summer, 1967), 30-34.

Recent Canadian developments in industrial research management.

JOHNSON, Harry G. "The Economics of the "Brain Drain': The Canadian Case," Minerva, III (Spring, 1965), 299-311.

The emigration and immigration of trained persons and the advantages of this process of talent exchange.

LARKE, John R. "At Ontario's New Centennial Centre of Science and Technology, the Word is PARTICIPATION," Can Sci, (Fall, 1967), 31-32.

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LEWIS, W. Bennett. "The Canadian Atomic Energy Project," BAS, VI (May, 1950), 139-141.

The organization and range of the Canadian atomic energy development.

Nature. "The Institute for Northern Studies, University of Saskatchewan," Nature, CXCVII (March 9, 1963), 960.

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NOBLE, William J. and K.D.C. HALEY. "Canadian Men of Science," Science, CXIX (February 5, 1954), 167-172.

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ORR, J. L. "Government Support of Canadian Industrial Research," Res Man, VII (January, 1964), 35-47.

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POPE, C. A. "The Defence Research Board, Canada," Nature, CLXXX (October 19, 1957), 782-783.

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SHOWALTER, H. A. "Government Support of Industrial Research and Development in Canada," Res Man, X (January, 1967), 51-60.

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THIESMEYER, Lincoln R. "The Pulp and Paper Research Institute of Canada," Res Man, VI (March, 1963), 163-175.

Organization and objectives of one of Canada's largest industrial research organizations.

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A survey of problems and policy.

5.2.4. AUSTRALIA

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This Australian department has greatly extended its operations and services since 1949, including expanded health research.

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CRAWFORD, J. G. "Administrative Aspects of Food and Agricultural Policy," Pub Ad Aus, XI, No. 3 (September, 1952), 95-107.

The objectives of the Australian food and agricultural policy and the suitability of the Commonwealth Department of Commerce and Agriculture to meet them.

DENNING, A. "The New South Wales University of Technology," Nature, CLXIV (July 30, 1949), 195-196.

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ENCEL, S. "Science and Government Policy," Pub Ad Aus, XXIV (June, 1965), 104-116.

Australian science policy problems.

FOX, F. A. "Management in the Scientific and Professional Field," *Pub Ad Aus,* XVIII (December, 1959), 313-325.

Analysis of research and development policy in the Australian Defence Standards Laboratory.

GARROW, C. "Some Aspects of the Administration of Scientific Research," *Pub Ad Aus,* XVI (December, 1957), 218-224.

Public administrators need a general knowledge of scientific developments in view of Australia's limited resources for research.

JACKA, C. K. "Conservation and Increased Food Production," *Pub Ad Aus,* XI, No. 4 (December, 1952), 169-189.

Bolder irrigation measures would benefit both food production and conservation in Australia.

JANSEN, Valma. "The Development of the Commonwealth Scientific and Industrial Research Organization," *Pub Ad Aus,* XIV, No. 3 (September, 1955), 166-175.

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KARMEL, P. H. "New Science Schools in the University of Adelaide," *Nature,* CCI (February 8, 1964), 553-555.

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MACKEY, G. W. "The Organization of the Meteorological Service," *Pub Ad Aus,* XIV, No. 3 (September, 1955), 180-184.

The history of meteorological work in Australia since 1906 and its relationship to the World Meteorological Organization.

McKNIGHT, A. D. "The Role of the Public Servant in Research," *Pub Ad Aus,* XX (June, 1961), 139-154.

The need for scientific research over the whole gamut of government activities, as based on Australian experiences.

MATHESON, J.A.L. "The Impact of Technology on Public Administration," *Pub Ad Aus,* XXII (March 1963), 19-25.

Generalized historical account of such impacts and their results.

MILLAR, T. B. "The Contribution of Academic Personnel and Research Institutions to Defence," Pub Ad Aus, XXV (March, 1966), 22-37.

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OVERHEU, D. L. "The Public Servant in the Future: Scientific and Automation Aspects," Pub Ad Aus, XXV (September, 1966), 202-211.

Technological innovations and their possible impact on the role of public servants in Australia.

PERES, Leon. "Organizing Science as a Means," Pub Ad Aus, XXIV (December, 1965), 287-297.

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________. "Research Organization and the Control of Incentives," Pub Ad Aus, XXII (December, 1963), 330-349.

The experience of the Australian government's sponsorship of civilian scientific research within the Commonwealth Scientific and Industrial Research Organization, (C.S.I.R.O.).

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More support for science and greater freedom from menial tasks, red tape, and other frustrations suggested.

MATHUR, K. N. "The National Physical Laboratory of India," *Nature*, CLIX (February 8, 1947), 184-186.

MENDE, Tibor. "India Sets Up First Asian T.V.A.," *Courier*, IV (May, 1951), 11.

The Damadar Valley Corporation to provide power in Bihar and Bengal.

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"Memorandum submitted to the Review Committee of the Council of Scientific and Industrial Research on National Research Laboratories by the Institute of Political and Social Studies."

________. "Indian University Reform IV: Science Education and Research," Minerva, VI (Autumn, 1967), 48-80.

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MUKERJEE, Dilip. "Indian Science: Policy, Organization and Application," Minerva, II (Spring, 1964), 360-369.

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Nature. "Central Laboratories for Scientific and Industrial Research, Hyderabad," Nature, CLXXIII (March 6, 1954), 422-424.

The opening ceremony of this institution in India, its aims and fields of research, and its finances.

________. "Council of Scientific and Industrial Research, India," Nature, CLXXV (January 1, 1955), 23-24.

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________. "Organization and Administration of Indian Science," Nature, CCIV (November 7, 1964), 528-529.

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PIEL, Gerard. "Role of Science in India's Self-Discovery," Nature, CCII (June 20, 1964), 1154-1155.

The kinds of technology India needs to import and encouragement for the development of indigenous science.

RAHMAN, A., et al. "National Laboratories in India," Nature, CCIII (August 8, 1964), 582-584.

Reports on an investigation of expenditure, personnel, and research output.

RAHMAN, A., N. SEN; and N. R. RAJAGOPAL. "Scientific Societies in India," *Nature*, CCIV (December 26, 1964), 1250-1252.

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RANGANATHAN, A. "Science in Modern India," *Impact*, IX (No. 4, 1959), 210-230.

Although present-day scientific progress in India is satisfactory, it is likely to be retarded in the future by the anti-scientific forces of traditionalism.

SAHA, Meghnad. "Science in Social and International Planning, with Special Reference to India," *Nature*, CLV (February 24, 1945), 221-224.

Balanced development of agriculture and industry is essential for India's progress and must be planned nationally.

SEN, S. N. "Scientific Strides of Modern India," *Courier*, II (May, 1949), 7.

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SINGH, Jagjit. "Scientific Research in India," *BAS*, XXI (February, 1965), 41-43.

Reports on the programs of the Indian Council of Agricultural Research, the Atomic Energy Commission, and The Council of Scientific and Industrial Research.

SWAMINATHAN, V. S. "Scientific and Industrial Research in India," *Am Sci*, LII (October, 1954), 625-638.

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THACKER, M. S. "Technical Education in India," *New Sci*, XV (September 13, 1962), 573-574.

Planning for an adequate supply of technically-trained personnel in India.

VARSHNEY, Y. P. "Central Glass and Ceramic Research Institute, India," *Nature*, CLIX (March 1, 1947), 290-292.

WHITAKER, J. W. "Fuel Research Institute of India," *Nature*, CLIX (March 1, 1947), 288-290.

5.2.10.3 ISRAEL

BEN-DAVID, Joseph. "Scientific Endeavor in Israel and the United States," ABS, VI (December, 1962), 12-16.

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BERGMANN, Ernst D. "Technical Strength for a New Nation," S+T (IST), LXXII (December, 1967), 62-69.

An Israeli scientist suggests, from Israel's experience, policies which would aid underdeveloped countries to utilize modern science and technology.

BOYKO, Hugo. "Farming the Desert," Sci Journal, IV, No. 5 (May, 1968), 72-78.

Israeli success with using techniques to use salt water for irrigation.

CALDER, Ritchie. "Science in a State of Siege," Nature, CCII (May 30, 1964), 843-847.

Discusses science in Israel.

________. "The Weizmann Institute--Laboratory for a Young Nation," New Sci, XXIV (December 10, 1964), 730-731.

The origin and operations of Israel's noted research institute.

GILLIS, J. "The Weizmann Institute," IST, LVI (August, 1966), 61-70.

Describes Israel's great research institution.

GOLDMAN, Edith. "Science in Israel," New Sci, III (April 24, 1958), 15-18.

An account of Israel's scientific and technological development in its ten years of existence.

McELHENY, Victor K. "Israel Worries About Its Applied Research," Science, CXLVII (March 5, 1965), 1123-1130.

The importance of applied research to the Israeli economy and water resources, and paradoxically, the strength of basic research.

SHIMSHONI, Daniel. "Israeli Scientific Policy," Minerva, III (Summer, 1965), 441-456.

The structure of science in Israel, obstacles to its growth, and alternatives for executing science policy.

5.2.10.4 LATIN AMERICA

CHAGAS, C. "Training of Scientists and Technicians in Latin America," Impact, XIII (No. 3, 1963), 201-212.

Problems involved stem from cultural traditions, social and economic environment, and defective educational systems.

FISHBEIN, Morris. "Medical Education in Latin America," JAMA,CXXXVII (May 1, 1948), 8-16.

HOUSSAY, B. A. "Organization of Scientific Research in Latin America," Nature, CLXXXVIII (December 31, 1960), 1157-1158.

Report of a reginal meeting arranged by UNESCO.

LOPES, J. Leite. "Science for Development - A View from Latin America," BAS, XXII (September, 1966), 7-11.

The historical processes which gave rise to the development of science in the advanced countries did not take place in a systematic and sustained way among today's underdeveloped countries.

MATVEYEV, A. "Science and Technology in the Development of Latin America," Impact, XV (No. 4, 1965), 205-210.

Report on the Conference on the Application of Science and Technology to the Development of Latin America.

ROCHE, Marcel. "Social Aspects of Science in a Developing Country," Impact, XVI (No. 1, 1966), 51-60.

The development of science in Venezuela, the favorable and unfavorable aspects of the social climate, and the need for a national coordinating body for science.

RUSK, Dean. "Science and Development in Chile," Nature, CCIV (December 5, 1964), 915.

Ways in which science can most effectively spur economic growth in Chile.

WRAY, John H. "Physics in Central America," Phys Today, XX (January, 1967), 42-52.

Comments by a North American physicist on physics research at universities in five countries.

5.2.10.5 NEW AFRICAN STATES

ADISESHIAH, M. S. "The Planned Development of Scientific Research in Africa," Impact, XIV (No. 3, 1964), 137-144.

Evaluates the Lagos Plan for research development in Africa.

ANDREWS, J. P. "Kumasi College of Technology, Gold Coast," Nature, CLXXII (October 3, 1953), 609-610.

Describes a new college offering courses in engineering, pharmacy, teacher training, commerce, and agriculture.

BULLARD, C. "The Royal Technical College of East Africa," Nature, CLXXIX (March 2, 1957), 450-451.

Describes a new college in Nairobi.

CALDER, Ritchie. "Congo Time Machine," New Sci, VIII (November 17, 1960), 1316-1318.

The state of science,and medicine in particular, when the Congo became independent.

EWUSIE, J. Yanney. "National Scientific Objectives and the Organization of Science in Ghana," Impact, XVI (No. 2, 1966), 131-139.

The Ghana Academy of Sciences is the coordinating body for research. The main scientific objectives are research in agriculture, industry, and medicine, and science education.

KEEN, B. A. "The East African Agriculture and Forestry Research Organization," Nature, CLXVIII (October 20, 1951), 674-676.

LANGER, Elinor. "Science in Africa: The Effects of Apartheid," Science, CLV (March 17, 1967), 1387-1389.

Discusses the question: "To what extent does science need freedom, and what kind of freedom does it need, in order to flourish?"

LARDNER, Godfrey E. A. "Science and Technology in Africa," BAS, XXIII (June, 1967), 36-39.

"The problem of making science and technology effective instruments for accelerating economics and social development."

Nature. "Research and Scientific Services in East Africa," Nature, CLXXIII (January 9, 1954), 65-67.

Reviews a survey by E. B. WORTHINGTON on developments from 1947-1951 and plans for the next five years.

NAUDÉ, S. M. "The South African Council for Scientific and Industrial Research," Nature, CLXXXIII (March 28, 1959), 853-857.

ODHIAMBO, Thomas R. "The East African Academy First Symposium and Inaugural Annual General Meeting," Nature, CXCIX (August 3, 1963), 439-441.

Synopses of the papers presented at the symposium and a description of the characteristics of the Academy.

OTIENO, N. C. "Today's Schools Prepare Tomorrow's African Scientists," Courier, XX (June, 1967), 33-36.

Education of scientists in Africa and the organizations and research institutes which require trained scientific and technical personnel.

United Kingdom. Ministry of Overseas Development. Staff and Technical Advisors. "Technical Co-Operation in the Production of Cotton: The New Crop in Central Africa," OECD Observer, No. 25 (December, 1966), 40-43.

The emergence of cotton as a key crop in Central Africa provides an example of the possibility that the transfer of skills and know-how by technical assistance may often be more valuable than monetary aid.

VOELCKER, O. J. "The West African Cacao Research Institute," Nature, CLX (January 24, 1948), 117-119.

The Institute was set up in 1947 in the Gold Coast to devise control programs against virus disease and pests which attack a major West African crop.

WILSON, Charles Morrow. "That More People May Live Better," Sci Mon, LXV (September, 1947), 199-206.

The Liberian Institute, an international medical research center.

WORTHINGTON, E. B. "Organization of Research in Africa," *Sci Mon*, LXXIV (January, 1952), 39-44.

Scientific research in Africa with reference to its organizational problems and its potential.

———. "Research Services in East Africa," *Nature*, CLXII (October 9, 1948), 554-556.

Research organizations set up under the Colonial Development and Welfare Act of 1945.

———. "Science in Africa," *New Sci*, VII (January 21, 1960), 151-153.

The recent organization of science in Africa is being affected by political changes.

5.2.10.6 OTHER COUNTRIES

GREECE

HANIOTIS, George V. "The Search for a National Scientific Policy in Greece," *Minerva*, III (Spring, 1965), 312-320.

The state of research in Greece and the work of a pilot team to study and recommend research policy.

MADDISON, Angus. "Technical Assistance and the Economic Development of Greece," *OECD Observer*, No. 14 (February, 1965), 6-11.

Summary of an OECD enquiry into the efficacy of foreign technical assistance in helping Greek economic development.

KOREA

EVERSULL, Frank L. "Korean Scientists Organize," *Sci Mon*, LXV (September, 1947), 243-245.

Describes the beginning of the Korean Association for the Advancement of Science on January 30, 1947.

NOBLE, Glenn A. "Science Education in Korea," Science, CVII (January 9, 1948), 31-32.

A survey of the material and non-material problems of laboratory work in Korea, especially as they affect the Japanese system as compared with the then recently-introduced American system.

PAKISTAN

FLECK, Alexander. "Science and Technology in India and Pakistan," New Sci, V (March 12, 1959), 563-566.

Report of the author's visit to the subcontinent, emphasizing the development of power resources.

Pakistan. Ministry of Industries. "Report of the Scientific Commission of Pakistan," Minerva, I (Autumn, 1962), 75-86.

Summary of the Commission's survey of scientific and technical resources in Pakistan and its science policy proposals.

SALAM, Abdus. "Pakistan: The Case for Technological Development," BAS, XX (March, 1964), 2-5.

The knowledge, wisdom and idealism of technical communities can help Pakistan acquire the skills to combat poverty. Includes statistics of national resources in the second five-year plan.

THIRLAWAY, H.I.S. "Probing Nature's Arid Land Mysteries," Courier, VIII (November, 1955), 48-50.

Artificial rain production and use of solar energy are two major schemes undertaken by UNESCO and the Pakistan Meteorological Service to develop the arid zones in that country.

PHILIPPINES

RAMIREZ, Conrado S. "Industrial Research in the Philippines," Res Man, V (November, 1962), 459-466.

Increased development of industrial research must await further economic growth and new economic policies.

TURKEY

KENNEDY, Edgar. "Training Turkish Youth for Future Scientific Needs," OECD Observer, No. 14 (February, 1965), 39-41.

The Center for the Production of Science Teaching Instruments was established in Turkey as an OECD pilot activity designed to show developing countries how to overcome the lack of laboratory equipment and raise their standards of science teaching.

YOZICIOGLU, Turgut. "Middle East Technical University, Ankara," Nature, CLXXXI (February 8, 1958), 382-383.

A new university in Turkey designed "to serve the requirements of the developing Middle East."

UNITED ARAB REPUBLIC

ALLISON, Samuel K. "Physics in Egypt: A New Type of Lend-Lease," BAS, XVI (October, 1960), 317-321; 335.

BORN, Max and L. J. F. BRIMBLE. "Science in Egypt," Nature, CLVIII (July 13, 1946), 43-46.

The educational and research institutions visited by the authors.

ISMAIL, Abdel Fattah. "Current Trends in Science Policy in the United Arab Republic," Impact, XII (No. 2, 1962), 103-118.

MITCHISON, Naomi. "Science in Egypt," New Sci, VII (April 28, 1960), 1073-1074.

Planning and progress report.

PASHA, A. M. Mosharrafa. "The Egyptian Academy of Sciences," Nature, CLVII (May 4, 1946), 573.

The purposes of the academy, which was founded in 1945.

RACCAH, Albert. "The Modern Pyramid of Aswan: Sadd El Aali," Courier, XIII (February, 1960), 44-45.

The Aswan High Dam will provide desperately needed farm land and water for Egypt as well as hydroelectric power.

SECTION 6

LEGAL ASPECTS OF SCIENCE AND TECHNOLOGY

The implications of science for law become evident in the numerous areas in which scientific innovations require regulation and control. Many of these innovations have given rise to public policy concerns and many of the legal questions that they involve have as yet been unresolved. Materials in this section are largely concerned with the legal system of the United States, but references to law in other countries and especially to international law are included.

Only one journal of the group surveyed for this bibliography, Lex et Scientia, is primarily concerned with substantive areas of law. Additional related materials in this rapidly developing area of public concern, the interaction of science and technology with law, are to be found in the law journals.

The reader may find those categories of section 4 which are obviously relevant to categories in section 6 useful in enlarging his appreciation of the effects of technological innovations on society. Additional relevant materials more or less closely concerned with the implications of science for law will be found in section 11.2, in which some of the interactions between science and ethics are discussed.

Questions of law regarding the initiation, organization, and administration of research and development programs have rarely been mentioned in the articles cited in this section. Other categories which include some materials in these areas are section 5 (e.g., 5.2.1.4.1, dealing with the United States Atomic Energy Commission), and section 10 (e.g., 10.4, in which some articles dealing with grants and contracts are cited).

6.1 GENERAL

ALEXANDER, Leo. "Protection of Privacy in Behavioral Research," Lex et Sci, IV (January-March, 1967), 34-38.

BARTENSTEIN, Fred, Jr. "Theft of Research Data: A National Menace," Res Man, VI (July, 1963), 251-258.

The actual theft of research data and the consequences for industries. Urges severe criminal law for the research thief.

BATE, Frank L. "The Protection of Company Knowledge from Theft-Legal Remedies," *Res Man*, VII (July, 1964), 253-259.

The legal concept of the theft of proprietary rights to knowledge is well recognized, as is the right to protection from such theft.

BLUMENSTEIN, Alfred. "Systems Analysis and the Criminal Justice System," *Annals*, CCCLXXIV (November, 1967), 92-100.

Report on "ways in which the National Crime Commission's Science and Technology Task Force has used a variety of quantitative approaches to study the operation of the criminal justice system."

CONNER, Troy B. "The Licensing of Power and Testing Reactors in the United States," *Lex et Sci*, III (January-March, 1966), 32-36.

Legal aspects of nuclear power development.

DOUGHERTY, Frank L. "The Loss of Proprietary Knowledge," *Res Man*, VII (September, 1964), 317-325.

Proprietary knowledge has real economic value and must be protected as a corporate asset.

FICARRA, Bernard J. "Sex Problems in Law," *Lex et Sci*, III (October-December, 1966), 228-240.

FRAMPTON, George T. "Radiation--Whose Responsibility?" *BAS*, XIV (December, 1958), 421-425.

Problems of domestic law and policy posed by nuclear radiation.

GREEN, Harold P. "The New Technological Era: A View from the Law," *BAS*, XXIII (November, 1967), 12-18.

The role of the legal profession in protecting society from the hazards of rapid technological advance.

Journal of the American Medical Association. "Survey of State Laws and Regulations for Radiation Control," *JAMA*, CLXXXIX (September 7, 1964), 799-783.

"This survey was conducted to determine the status of state ionizing radiation laws and regulations in relation to their effects on health and medical practice."

PALFREY, John G. "Law and Science in Atomic Energy," Lex et Sci, II (July-September, 1965), 218-231.

A member of the U.S. Atomic Energy Commission discusses the U.S. atomic energy law and problems of law and science in this field.

SACHAR, Edward J. "Behavioral Science and Criminal Law," Sci Am, CCIX (November, 1963), 39-45.

Explores "some of the differences in order to delineate more clearly the areas of potential collaboration between the lawyer and the behavioral scientist."

WEIGEL, William F. "Secrecy and Invention Agreements," Res Man, VII (July, 1964), 241-251.

Secrecy and invention agreements exemplify the need of the corporate employer to protect himself from his own employees.

6.2 INTERNATIONAL LAW

6.2.1 GENERAL

HAYTON, Robert D. "The 'American' Antarctic," AJIL, L (July, 1956), 583-610.

________. "The Antarctic Settlement of 1959," AJIL, LIV (April, 1960), 349-371.

The history and provisions of the Antarctic Treaty and future prospects for the cooperative development of the continent.

HOSTIE, Jan F. "Problems of International Law Concerning Irrigation of Arid Lands," Int Aff, XXXI (January, 1955), 61-69.

ROUSSEAU, Charles. "Scientific Progress and the Evolution of International Law," Impact, V (June, 1954), 71-92.

Scientific discoveries have influenced development of international law mainly by extending the jurisdiction of states, influencing the system by which such jurisdiction is exercised and altering the conditions in which the law of war is applied.

SCHROEDER, Peter B. "The Radio Amateur in International Legislation and Administration," AJIL, XLVIII (July, 1954), 421-433.

TOMA, Peter A. "Soviet Attitude Towards the Aquisition of Territorial Sovereignty in the Antarctic," AJIL, L (July, 1956), 611-626.

6.2.2 MARINE LAW

ANDREWS, John A. "Who Owns the Resources of the Sea?" New Sci, XVIII (May 9, 1963), 307-309.

Problems of international law regarding territorial waters, the high seas, and the continental shelf.

BOGGS, S. Whittemore. "Delimitation of Seaward Areas Under National Jurisdiction," AJIL, XLV (April, 1951), 240-266.

Discusses problems of delimiting boundaries in water areas and attempts to formulate principles and techniques that might be generally used.

DEAN, Arthur H. "The Geneva Conference on the Law of the Sea: What Was Accomplished," AJIL, LII (October, 1958), 607-628.

The head of the U.S. delegation reports on the first worldwide conference on maritime law since 1930. (See also same author, "The Second Geneva Conference on the Law of the Sea: The Fight for Freedom of the Seas," ibid., LIV, October, 1960, 751-789.

KUNZ, Josef L. "Continental Shelf and International Law: Confusion and Abuse," AJIL, L (October, 1956), 828-853.

Freedom of the high seas is threatened by unilateral claims to resources of the continental shelf.

PARKS, Larry G. and Stuart S. DYE. "Ocean Resource Development and the Law of the Sea," Lex et Sci, III (April-June, 1966), 107-116.

Legal problems concerning the use of the sea and its resources cannot be solved without considering political, military, industrial, sociological, scientific, and economic aspects of the problem.

PONTECORVO, Giulio. "The Law of the Sea," BAS, XXIII (April, 1967), 46-48.

A Conference of the Law of the Sea Institute of the University of Rhode Island provided a forum for the Navy and those with fishing, oil, and mining interests in the sea.

SELAK, Charles B., Jr. "Recent Developments in High Seas Fisheries Jurisdiction Under the Presidential Proclamation of 1945," AJIL, XLIV (October, 1950), 670-681.

Discusses the U.S. attempt to establish conservation zones in areas of the high seas where considerable fishing is carried on.

WHITEMAN, Marjorie M. "Conference on the Law of the Sea: Convention on the Continental Shelf," AJIL, LII (October, 1958), 629-659.

YOUNG, Richard. "The Legal Status of Submarine Areas Beneath the High Seas," AJIL, XLV (April, 1951), 225-239.

Reviews some of the problems of jurisdiction over submarine areas and suggests some lines of future development.

________. "Recent Developments with Respect to the Continental Shelf," AJIL, LXII (October, 1948), 849-857.

Reviews the actions of the U.S. and several Latin American nations in extending their sovereignty over the continental shelf and sea bed.

6.2.3 SPACE LAW

ANDREWS, John. "Could a Nation Annex the Moon?" New Sci, X (April 20, 1961), 103-104.

A system of international control would be advisable, but United Nations efforts to work this out have so far been fruitless.

Bulletin of the Atomic Scientists. "International Control in Space: 1967," BAS, XXIII (March, 1967), 46-48.

"Text of the treaty on principles governing the activities of states in the exploration and use of space."

CHENG, Bin. "Problems of Space Law," New Sci, VII (May 19, 1960), 1256-1258.

Discusses the application of existing international law to space activities.

CRANE, Robert D. "Soviet Attitude Toward International Space Law," AJIL, LVI (July, 1962), 685-723.

Article by the Director, Space Research Institute, World Rule of Law Center.

GALINA, A. "The Law of Outer Space," ABS, III (December, 1959), 19-24.

A Soviet writer reviews Western opinions and presents Soviet views concerning internationalization of outer space.

HANEY, G. Mickey and James D. THOMPSON. "Communication Satellites," IST, LXI (January, 1967), 46-60.

Most of the technical problems for communications satellites have been worked out, but political questions remain, such as jurisdiction over domestic systems and ownership of earth-stations.

HOGAN, John C. "Legal Terminology for the Upper Regions of the Atmosphere and for the Space Beyond the Atmosphere," AJIL, LI (April, 1957), 362-375.

Attempts to clarify terminology which will be used in astronautical jurisprudence.

LOVELL, Bernard. "Why the Space Treaty Matters," New Sci, XXXI (August 11, 1966), 306-307.

An international space treaty would bring about more rational progress in space exploration than the present competitive conditions allow.

McDOUGAL, Myres S. and Leon LIPSON. "Perspectives for a Law of Outer Space," AJIL, LII (July, 1958), 407-431.

Suggests some of the problems that are likely to arise in the use of outer space, and appraises "proposed organizational arrangements for control of activities in outer space."

PEPIN, Eugène. "Space Flight and the Rule of Law," Courier, XIX (May, 1966), 17-18; 35-37.

The U.N. has set out general principles for the use of outer space, but the details need to be worked out in an international agreement.

SIMSARIAN, James. "Outer Space Co-operation in the United Nations," AJIL, LVII (October, 1963), 854-867.

Cooperative action in outer space both within the United Nations and among member countries.

WEHRINGER, Cameron K. "Space, Law and War," *Lex et Sci,* IV (October-December, 1967), 191-206.

Predicts legal problems that will arise as military uses of space become more feasible.

6.2.4 NUCLEAR ENERGY AND ARMAMENTS

D'AMATO, Anthony A. "Legal Aspects of the French Nuclear Tests," *AJIL,* LXI (January, 1967), 65-77.

FALK, Richard A. "The Shimoda Case: A Legal Appraisal of the Atomic Attacks Upon Hiroshima and Nagasaki," *AJIL,* LIX (October, 1965), 759-793.

This case points out some of the legal problems arising from the use of nuclear weapons.

HOHENEMSER, Christoph and Milton LEITENBERG. "A Comprehensive Nuclear Test Ban: Technical Aspects, 1957-1967," *Sci Cit,* IX (November-December, 1967), 197-209.

Organization for Economic Cooperation and Development. "OECD Convention on Liability for Nuclear Damage," *OECD Observer,* No. 22 (June, 1966), 36-39.

A novel and uniform set of rules intended to guide decision on compensation for personal or property damage resulting from a "nuclear incident" in Western Europe.

________. The Work for Nuclear Safety in Europe," *OECD Observer,* No. 4 (June, 1963), 14-18.

An essential function of the European Nuclear Energy Agency is to work out supervision and protection measures for the handling, transport, and processing of radioactive materials.

SCHWELB, Egon. "The Nuclear Test Ban Treaty and International Law," *AJIL,* LVIII (July, 1964), 642-670.

STASON, B. Blythe. "Law and Atomic Energy," *Annals,* CCXLIX (January, 1947), 89-98.

Considers some of the legal problems of atomic energy use, domestic and international.

WILLRICH, Mason. "International Control of Civil Nuclear Power," BAS, XXIII (March, 1967), 31-38.

A lawyer discusses the requirements for effective control of nuclear industry.

________. "Safeguarding Atoms for Peace," AJIL, LX (January, 1966), 34-54.

Legal aspects of the revised International Atomic Energy Agency system of safeguards to ensure peaceful uses of atomic energy.

6.3 PATENTS

BENJAMIN, Curtis. "Computers and Copyrights," Science, CLII (April 8, 1966), 181-184.

Presents ideas on how restrictions on computer use of copyrighted material would protect authors, publishers, and users.

BERGIER, Jacques. "New Trends in the Sociology of Invention: Know-How vs. Patent," Impact, IV (Autumn, 1953), 167-179.

Describes the origins of the concept of patents, and the heyday of the patent and its eventual depreciation in value, followed and accompanied by the concept of know-how.

BLOHM, Clyde L. "Patent Policies and Practices of Research Institute Companies," Res Man, I (Autumn, 1958), 173-177.

A survey by the Industrial Research Institute of its 140 member companies, based on calendar year 1956 data.

BYERS, Harold. "Criteria of Patentability," Sci Mon, LXII (May, 1946), 435-439.

Includes benefits of taking out patents, requirements for the inventor, and the powers that the patent gives the holder of the patent rights.

CARNEY, Thomas P. "Research and Patents in the Drug Industry," Res Man, V (May, 1962), 193-208.

Proposed patent legislation discriminates against the drug industry and, if passed, would destroy creative research.

HAWKINS, L. A. "Does Patent Consciousness Interfere with Cooperation Between Industrial and University Research Laboratories?" *Science*, CV (March 28, 1947), 326-327.

The patent system as it relates to industrial and non-industrial research laboratories.

HESSE, E. G. "A Discussion of the Current World Wide Attack on the Patent System as it Particularly Affects the Pharmaceutical Industry," *Lex et Sci*, I (No. 2, 1964), 133-144.

HOLLOMON, J. Herbert. "The U. S. Patent System," *Sci Am*, CCXVI (June, 1967), 19-27.

Discusses U.S. patent law and the proposed revision.

Impact of Science on Society. "The Right to Scientific Property," *Impact*, V (Spring, 1954), 47-68.

Introductory Report on Scientists' Rights prepared by the UNESCO Secretariat. Extensive bibliography.

JONES, Stacy V. "The Patent Haystack," *Ind Res*, V, No. 2 (February, 1963), 34-39.

Information retrieval at the Patent Office is becoming more difficult because of the lack of data process development in the patent system.

KALTENECKER, H. "Practice and Policy of the European Space Research Organization (ESRO) Concerning Intellectual Property Rights, Access to and Disclosure and Use of Information," *Lex et Sci*, IV (July-September, 1967), 156-164.

LEVY, S. I. "Patents in a Changing World," *New Sci*, XXIV (November 26, 1964), 574-576.

Discusses the need to revise British patent law to accomodate advances in science and technology.

LISTER, Gordon K. "Government Patent Rights," *BAS*, I (May 15, 1946), 15-16.

Discusses the primary function of the patent system, government policy regarding inventions, and atomic energy patents.

LUECK, Roger H. "Patents from Federally Financed Research: Title vs. License Policy," Res Man, V (March, 1962), 131-142.

Discusses the Federal Inventions Administration Act, S. 1176, and argues that license policy is preferable to title policy.

LUZZATTO, Ettore. "The Proposed European Patent Convention and the Protection of Scientific Property," Lex et Sci, III (July-September, 1966), 127-134.

McGOVERN, William C. "The American Patent System and Antitrust Laws: The Mythical Conflict," Res Man, V (May, 1962), 151-166.

Argues that the courts have in practice found a stable balance between patent laws and antitrust laws. Extensive bibliographic footnotes.

MACHLUP, Fritz. "Patents and Inventive Effort," Science, CXXXIII (May 12, 1961), 1463-1466.

Discusses the importance of patent protection in inducing inventive activity in the U. S.

McKENZIE, Lawson M. "Scientific Property," Science, CXVIII (December 25, 1953), 764-767.

Discussion of copyrights, patents, right to credit, duties of scientific administrator regarding scientific property, and legal protection.

MILLER, Byron S. "The First Official Report on AEC Patent Problems," BAS, IV (March, 1948), 77-79.

Gives a critical summary of the conclusions of the report.

MUNSTER, J. H. Jr., and Justin C. SMITH. "The Care and Feeding of Intellectual Property," Science, CXLVIII (May 7, 1965), 739-743.

The problems of legal protection of "property rights" in ideas, including the question of patents.

________. "Savants, Sandwiches and Space Suits," Science, CXLV (September 18, 1965), 1276-1281.

The proprietary rights of universities in patentable items and research and in development resources.

NEUMEYER, Fredrik. "The Employed Inventor-Part I: The European Situation," Lex et Sci, II (October-December, 1965), 233-242.

Discusses legal obligations and rights of employed inventors. (See also idem., "The Employed Inventor-Part II: The American Situation," 243-265 of this issue.)

PALMER, Archie M. "Medical Patents," JAMA, CXXXVII (June 5, 1948), 497-508.

Discusses the patent policies of medical schools.

Scientific Research. "Revolutionizing the U. S. Patent System," Sci Res, II (April, 1967), 42-44.

Discusses the Administration bill designed to simplify the patent system and key the U. S. to worldwide patent systems.

SHELTON, J. P. "An Aspect of Public Policy on Technological Innovation," Pub Ad Aus, XXIII (December, 1964), 359-371.

The experiences of patent-handling bodies in several countries and how these experiences may apply to Australia.

SUTER, C. M. "Patent Equity and the Scientist in Pharmaceutical Research," Res Man, X (July, 1967), 263-273.

Argues that patent equity is essential to justify the expense of research in the pharmaceutical research laboratory.

WHALE, Arthur R. "Securing the Benefits of Science for Human Welfare," Lex et Sci, II (January-March, 1965), 77-85.

Describes the usefulness of the patent system as a link between the discoveries of the scientists and their application for the public good.

WRIGHT, Robert L. "U. S. Patent Policy and Government Research," BAS, XIX (December, 1963), 9-13.

The problem of the disposal of patent rights in inventions produced by government-financed research and development.

6.4 BIOMEDICAL

ALEXANDER, Leo. "Limitations on Experimental Research on Human Beings," Lex et Sci, III (January-March, 1966), 8-24.

The origin and application of the Nuremberg Code as a standard for scientists in experimentation involving human subjects.

ARBUSE, David I. and Bernard ARBUSE. "Abortion, Psychiatry, and the Law," Lex et Sci, I (No. 2, 1964), 193-197.

The need for changing U. S. abortion laws.

BALLARD, Robert W. "Patient Consent in Experimental Drug Therapy," Lex et Sci, I (January-March, 1964), 216-221.

BARROW, Roscoe L. and Howard D. FABING. "Our Changing Epilepsy Laws," Lex et Sci, II (January-March, 1965), 153-161.

BIRNBAUM, Morton. "Eugenic Sterilization," JAMA, CLXXV (March 18, 1961), 951-958.

Discusses legal, moral, and medical aspects of the problem and offers some partial solutions.

BÖVING, Bent G. "Laboratory Animal Legislation Dangers," Bio Sci, XVII (November, 1967), 771-773.

Recent Congressional action has imposed severe restrictions on scientific research which might improve human life without substantially bettering the lot of laboratory animals.

CAMPS, F. E. "Defining Death," Sci Journal, III, No. 6 (June, 1967), 81-84.

Medical techniques which can maintain heartbeat and respiration after these functions have failed invalidate traditional definitions of death and create new problems for law and medicine.

COX, Hiden T. "How About a New Frontier in This Alley?" AIBS Bulletin, XI (February, 1961), 11-16; 20.

Reviews the reactions of biologists to proposed federal legislation to regulate the use of animals in research.

CURRAN, William J. "Legal Codes in Scientific Research Involving Human Subjects," *Lex et Sci*, III (April-June, 1966), 65-73.

Briefly describes American and international law in this field.

DEPEW, Franklin M. "Some Aspects of Food Additive and Residue Regulations that Concern Industry Scientists," *Lex et Sci*, II (January-March, 1965), 9-16.

DOWLING, Harry F. "Human Dissection and Experimentation with Drugs," *JAMA*, CCII (December 25, 1967), 72-75.

Compares the problem of drug trials on humans with the historic controversy over cadaver dissection and urges sensible legislation.

FICARRA, Bernard J. "Artificial Insemination: A Medico-Legal Concern," *Lex et Sci*, IV (January-March, 1967), 48-62.

________. "Thyroidectomy and Malpractice," *Lex et Sci*, I (1964), 198-204.

Injury to the larygneal nerve is a possible occurrence in thyroidectomy. Some preventive measures to be taken by the physician to avoid malpractice suits and the need to lessen the frequency of legal actions brought against the medical profession.

HOLMAN, Edwin J. "Medicolegal Aspects of Sterilization, Artificial Insemination, and Abortion," *JAMA*, CLVI (December 4, 1954), 1309-1311.

Journal of the American Medical Association. "Medicolegal Aspects of Artificial Insemination," *JAMA*, CXLVII (September 15, 1951), 250-253.

________. "Medico-Legal Problems and Their Solutions," *JAMA*, CLXV (October 12, 1957), 699-705.

Discusses current problems of professional liability and medicolegal testimony.

KUMMER, Jerome M. and Zad LEAVY. "Therapeutic Abortion Law Confusion," *JAMA*, CXCV (January 10, 1966), 96-100.

A discussion of the incidence of abortion in the U. S., present laws and their background, and recommended modifications.

LADIMER, Irving. "Human Experimentation: Medicolegal Aspects," *NEJM*, CCLVII (July 4, 1957), 18-24.

LASAGNA, Louis. "Problems of Drug Development," *Science*, CXLV (July 24, 1964), 362-367.

Society's handling of the problems created by the pharmacological revolution of the last quarter century leaves much to be desired.

MODELL, Walter. "Mass Drug Catastrophes and the Roles of Science and Technology," *Science*, CLVI (April 21, 1967), 346-351.

The roles of science and technology in the causation, control, and prevention of poisoning from the new mass drugs. . .alcohol, narcotics, and the psychedelic drugs.

SADUSK, Joseph F., Jr. "Hazardous Fields of Medicine in Relation to Professional Liability," *JAMA*, CLXIII (March 16, 1957), 953-958.

Summarizes hazardous fields and lists principles of prevention.

________. "The Physician and the Food and Drug Administration," *JAMA*, CXC (December 7, 1964), 907-909.

SEEVERS, Maurice H. "Perspective Versus Caprice in Evaluating Toxicity of Chemicals in Man," *JAMA*, CLIII (December 12, 1953), 1329-1333.

Discusses legislation regarding food additives and other chemical products and suggests basic principles upon which to base evaluation of toxicity.

THOMAS, Richard K. "Judging Scientific Fact in Pharmaceutical Advertising," *Lex et Sci*, III (October-December, 1966), 212-215.

TIETZE, Christopher and Hans LENFELDT. "Legal Abortion in Eastern Europe," *JAMA*, CLXXV (April 1, 1961), 1149-1154.

VISSCHER, Maurice B. "The Congress and Animal Experimentation," *JAMA*, CXCVI (June 20, 1966), 1053-1054.

(See also *idem*., "Medical Research and Ethics," *JAMA*, CXCIX, February 27, 1967, 631-636, in which the morality of experimentation on animals is discussed.)

WAITE, Frederick C. "The Development of Anatomical Laws in the States of New England," *NEJM*, CCXXXIII (December 13, 1945), 716-726.

History and present provisions of anatomical laws.

WAKERLIN, G. E. and J. F. SEMBOWER. "Legal Aspects of Medical Research," *JAMA*, CXLI (October 15, 1949), 429-431.

The need for positive legislation to support medical research.

WILLIG, Sidney H. "The Control Over Interstate Distribution and Use of Investigational Drugs," *Lex et Sci*, IV (April-June, 1967), 110-119.

WOLDER, Stanley and Alfred HALPERN. "Medical Specialization and the Law," *Lex et Sci*, I (No. 1, 1964), 42-50.
A physician may claim a specialization without being hindered by governmental regulations.

6.5 LOYALTY, SECURITY, SECRECY

American Association for the Advancement of Science. Board of Directors. "Strengthening the Basis of National Security," *Science*, CXX (December 10, 1954), 957-959.

Traditional attitude toward security in scientific matters, based on the mistaken view that security measures safeguard large amorphous categories of information, is criticized and a more positive approach is advocated.

________. Special Committee on Civil Liberties for Scientists. "Civil Liberties of Scientists," *Science*, CX (August 19, 1949), 177-179.

Summary report of the committee's findings.

COMMONER, Barry. "The Eroding Integrity of Science," *S+T (IST)*, LXX (October, 1967), 51-60.

Secrecy, specialization, and simplistic approaches are examples of social and political pressures that break down the integrity of science.

________. "Integrity of Science," *Sci Journal*, II,No. 4 (April, 1966), 75-79.

Since the scientist must explain his work to a wide public, too much secrecy frustrates decisions about science and may also frustrate scientific development itself.

EDSALL, John T. "Government and the Freedom of Science," *Science*, CXXI (April 29, 1955), 615-619.

Argues against U. S. policy of denying research grants for unclassified research to scientists whose loyalty may be seriously doubted.

FELD, Bernard T. "Let's Abolish Classification in the Atomic Power Field," BAS, XI (June, 1955), 219-220.

Points out advantages of declassification.

GLENNAN, T. Keith. "Industrial Participation in the Atomic Energy Program," Am Sci, XLII (January, 1954), 96-103.

The classification of scientific and technological information has hindered the participation of industry and therefore classification procedures should be revised.

GREEN, John C. "Scientific Information from Enemy Sources and Government-Sponsored Research," CEN, XXIV (July 10, 1946), 1795-1799.

The advances in research and technology made secretly during W. W. II, which information must now be disseminated and reconverted to peaceful uses.

GREEN, Harold P. "The AEC Proposals - A Threat to Scientific Freedom," BAS, XXIII (October, 1967), 15-17.

New security regulations proposed by the Atomic Energy Commission raise a threat to academic freedom and free scientific inquiry.

HUGHES, Donald J. "Positive Aspects of the Release of Secret Information," BAS, XII (May, 1956), 169-172.

Statement before the House Subcommittee on Government Information on the availability of scientific and technical information.

HUTCHINSON, Lt. Col., W. S., "The Manhattan Project Declassification Program," BAS, II (November 1, 1946), 14-15.

Policy is to protect vital secrets of atomic science affecting national security and to disseminate basic mathematics, chemistry, and physics developed by the project during the war.

KARSNER, Howard T. and Robert A. PHILLIPS. "Academic Freedom in Military Medical Research," JAMA, CLIII (December 12, 1953), 1356-1357.

KREBS, William A. W., Jr., and Carmel P. EBB. "The New Immigration Law," Science, CXVII (March 20, 1953), 287-289.

Reviews sections of the McCarran-Walter Act relevant to scientists, particularly those excluding foreign scientists from visiting the U. S.

LEACH, W. Barton. "Meeting Ground of Law and Science in War: Operations Analysis in the USAAF, 1942-45," Lex et Sci, II (January-March, 1965), 163-171.

LIVINGSTON, M. Stanley. "Science and Security," Annals, CCC(July, 1955), 4-12.

Discusses the security problem in the U. S. as it affects scientists and suggests a re-evaluation of the meaning and purpose of the security program.

MANLEY, John H. "Secret Science," Phys Today, III (November, 1950), 8-16.

The formation of policy for declassifying scientific information and the procedures which are followed.

O'BRIAN, John Lord. "Loyalty Tests and Guilt by Association," BAS, IV (June, 1948), 166-172.

Although this was a problem currently of much concern to scientists, scientists as such are not mentioned in this article, which reviews previous restrictive legislation.

PHELPS, John B. and Ernest C. POLLARD. "Physics, Physicists, and Security," Phys Today, IX (December, 1956), 23-26.

Describes new developments in the Soviet Union and the U. S. which call for modifications in security measures.

PIEL, Gerard. "Science, Censorship and Public Interest," Science, CXXV (April 26, 1957), 792-794.

Reviews and criticizes the policies of the House Moss Committee on Government Information Policies on secrecy problems in science.

ROSEBURY, Theodor and Melba PHILLIPS. "Two Aspects of the Loyalty Problem," Science, CX (July 29, 1949), 123.

Criticizes loyalty oaths required by applicants for federal science grants, and states loyalty is to one's country and not to institutions or elected officers.

The Scientists' Committee on Loyalty Problems. "The First Year of the SCLP," Science, CXI (March 3, 1950), 220-225.

Discusses Committee's work with the immediate practical problems facing scientists.

SMYTH, Henry DeWolf. "Science and Secrecy," Phys Today, VI (March, 1953), 14-16.

The benefits of free exchange of scientific information and the conditions under which secrecy is essential.

SPEDDING, F. H. "Chemical Aspects of the Atomic Energy Problem," BAS, V (February, 1949), 48-50.

Technical problems faced by chemists engaged in atomic research and the relation of science and security.

TAEUSCH, Carl E. "The Unlisted Freedom: Science," Sci Mon, LXXV (July, 1952), 12-18.

Freedom of science, once taken for granted, is now being reduced through the demands of national security and loyalty oaths.

WRIGHT, Quincy. "The Politics of Nuclear Secrecy," Science, CXLIV (June 5, 1964), 1208-1209.

6.6 ENVIRONMENTAL CONTROL

Chemical and Engineering News. "Federal Role in Air Pollution Debated," CEN, XLI (September 21, 1963), 27-28.

The chemical industry's view that air pollution control should be left to local authorities.

DIXON, James P. "For Air Conservation," BAS, XXI (June, 1965), 7-12.

Calls for air conservation as an objective of public policy.

Environmental Science and Technology. "Aircraft Noise: Unrelenting, Unremitting, Intolerable," EST, I (December, 1967), 976-983.

Discusses recent legislation and technological advances relevant to the problem of aircraft noise.

________. "Pollution Laws in the U. S.," EST, I (January, 1967), 18-22.

Federal involvement in pollution control has increased greatly in twenty years. (See also idem., "Congress Takes a Hard Line on Air Pollution," EST, I, February, 1967, 119-123, which describes proposed Congressional legislation on air pollution, and idem., "Air Quality Act of 1967 Now a Matter of Fact," EST, I, November, 1967, 884-887, in which the provisions of the new legislation to control air pollution are discussed.)

FINK, Thomas A. "The Law and the Water," Sci Cit, IX (March, 1967), 50-54.

"Only in the 1960's have we started to enact comprehensive legislation to give the government the power to save our remaining water supply."

KNEESE, Allen V. "New Directions in Water Management," BAS, XXI (May, 1965), 2-8.

A control system that effectively combines many measures and urges the use of regional water management agencies in order to abate pollution.

LESTER, A. P. "River Pollution in International Law," AJIL, LVII (October, 1963), 828-853.

There is need for an elaboration of international law to govern cases of international river pollution.

MIDDLETON, John T. "A Fresh Opportunity for Industry," EST, I (March, 1967), 206-211.

"The proposed Air Quality Act of 1967 is an unprecedented opportunity for the business community to carry out its responsibility for controlling the growing problem of air pollution in this country."

SECTION 7

EDUCATION AND PUBLIC UNDERSTANDING OF SCIENCE

Topics dealt with in section 7.1 include public attitudes toward science and scientists; the increasing requirement for public understanding of science as it relates to social and political concerns; and the role of science in general education.

Section 7.2 cites articles concerned with the role of science education in general higher education; many of these emphasize the social contexts of science and technology and the necessity for the integration of science in "liberal education." But many aspects of education are found in other sections of the bibliography. Articles dealing with the education of scientists and engineers will be found in section 5, and especially in section 8.2. Additional related materials on the impacts of science and technology on universities, and research and development activities in universities, will be found in sections 5 and 10.4. Section 11.1 cites some articles dealing with relationships between the sciences and the humanities in higher education.

Section 7.3 deals with possibilities of increasing the public understanding of science through other channels than formal educational systems. The use of the mass media to convey and interpret information about science to the general public is discussed, as are some of the problems of popularizing science.

7.1 GENERAL

ARON, Raymond. "The Education of the Citizen in Industrial Society," Daedalus, XCI (Spring, 1962), 249-263.

Is the citizen in a democracy capable of fulfilling his functions in the complexity of scientific society?

ASHBY, Eric. "Investment in Man," Nature, CXCIX (Supplement to Nature of August 31, 1963), 877-883.

The advancement of science depends upon investment in the education of man.

BAUM, Werner A. "Education for the Emerging Scientific Culture," *Ed Rec,* XLIII (January, 1962), 44-47.

The kind of knowledge and understanding of science and technology needed in education for life in the scientific culture.

BIBBY, Cyril. "Science as an Instrument of Culture," *Nature,* CCII (April 25, 1964), 331-333.

Urges that science become central in the system of education as a corrective to excessive verbalism and imprecision.

BRIMBLE, L.J.F. "The Exposition of the Truth," *BAS,* IV (May, 1948), 141-144.

The best means of accurately disseminating information on scientific fact and method.

BRONOWSKI, Jacob. "The Educated Man in 1984," *Science,* CXXIII (April, 1956), 710-712.

Faults of the traditional non-scientific education are analyzed and criticized, with suggestions that all citizens have some experience with science and be familiar with its language. (See also *idem.*, same title, *Adv Sci,* XII, December, 1955, 301-306.)

CALDER, Ritchie. "The Fragmentation of Science," *Adv Sci,* XII (December, 1955), 328-338.

Deals with overspecialization within science itself, its divorce from the humanities, and its incomprehensibility to the public with the political consequences this attitude brings.

CARLSON, Anton J. "Science, Education, and the Future of Man," *Sci Mon,* LXV (December, 1947), 498-502.

The scientist and educator bear special responsibility for shaping man's future in coping with such problems as population growth, conservation of natural resources, and putting an end to war and violence.

CHAMBLISS, John L. "A Layman Looks at Science," *Sci Mon,* LXIV (June, 1947), 464-468.

The first job of scientists is to explain the world to the layman by the use of facts and a coherent philosophy to contain the facts.

COHEN, I. Bernard. "The Education of the Public in Science," Impact, III (Summer, 1952), 67-100.

Education in science and the meaning of progress in relation to science, with recommendations for a wider diffusion of an understanding of science by all citizens. Extensive bibliography.

CONANT, James Bryant. "On Understanding Science," Am Sci, XXXV, No. 1 (January, 1947), 33-35.

The historical approach to science can give a better understanding of it to those who will mold and lead society.

DART, Francis E. and Panna Lal PRADHAN. "Cross-Cultural Teaching of Science," Science, CLV (February 10, 1967), 649-656.

The intellectual climate in which children live may lead to better science teaching.

DECKER, Fred W. "Scientific Communications Should Be Improved," Science, CXXV (January 18, 1957), 101-105.

Criticizes scientific reports to the public for their extreme brevity, inconclusive evidence, and for being directed by commercial interests in areas of science having a direct bearing on society.

De KIEWIET, Cornelis W. "Education for Survival," Sci Mon, LXXVI (February, 1953), 57-62.

The field of human relations, not science and technology, is most important for national survival.

DICK, William E. "Science and the Press," Impact, V (September, 1954), 143-173.

Various aspects of the relationship between science and the press.

DUBOS, René. "Scientist and Public," Science, CXXXIII (April 21, 1961), 1207-1211.

Examines present social attitudes toward the scientist and compares them with earlier attitudes.

ELLEGÅRD, Alvar. "Public Opinion and the Press: Reactions to Darwinism," JHI, XIX (June, 1953), 379-387.

A program for studying the relation of ideas and public opinion, using Darwinism as a model.

FRANK, Nathaniel H. "Science and National Affairs," Phys Today, VII (May, 1954), 10-14.

The growing impact of science challenges educators to impart interest and knowledge of an expanding subject in a minimum length of time.

GOMER, Robert. "Vox Populi," BAS, XVIII (June, 1962), 32-33.

Because of the inert, uninformed general public's political power, dangerous policies are being followed to the exclusion of intelligent alternatives.

GRAUBARD, Mark. "The Frankenstein Syndrome: Man's Ambivalent Attitude to Knowledge and Power," PBM, X (Spring, 1967), 419-443.

Attitudes towards knowledge-seeking enterprises, from ancient times to the present.

HAFSTAD, Lawrence R. "Science, Technology, and Society," Am Sci, XLV (March, 1957), 157-168.

Although the humanists control the direction of society, it is the scientists and technologists who make the greatest contribution to it.

HOLTON, Gerald. "Modern Science and the Intellectual Tradition," Science, CXXXI (April 22, 1960), 1187-1193.

Science occupies a dangerously narrow place in our culture and too few understand it properly despite the vast number of present-day scientific achievements.

HOWE, Quincy. "Science and the Public," BAS, XII (November, 1956), 341-342.

The interactions of science, government, and the public which have resulted from improved communications.

INGLE, Dwight J. "The Uses of Efficiency in Science and Education," PBM, V (Spring, 1962), 356-363.

Reviews some of the factors "which limit achievement in science and education" in the U. S.

LARK-HOROVITZ, Karl. "Science for the Non-Scientist," MCMT, VII (Autumn, 1949), 77-79.

Challenges presented to secondary and higher education by the fact that we live in an "age of science."

LILIENTHAL, David E. "Science and Man," CEN, XXXVI (September 29, 1958), 114-124.

How science will influence the mind of man in regard to his outlook on life, his attitude toward people, and his self-understanding.

LONSDALE, Kathleen. "Scientists and the People," BAS, XIV (September, 1958), 242-245.

A commentary on the scientist's public image and place in society.

McCURDY, Richard C. "Public Must Be Literate in Science," CEN, XXXVI (November 3, 1958), 62-67; 99.

As human problems become more interwoven with science and technology, a rough idea of natural philosophy is becoming a "must" for liberal education.

MATHEWSON, James H. "Science for the Citizen: An Educational Problem," Science, CXXXVIII (December 28, 1962), 1375-1379.

The various aspects of educating the non-scientist citizen to understand the purposes and methods of science.

MULLER, Hermann J. "The Role of Biology in General Education," AIBS Bulletin, XIII (August, 1963), 22-30.

Man's new-found ability to influence life procedures makes understanding of biology imperative.

PIEL, Gerard. "Need for Public Understanding of Science," Science, CXXI (March 4, 1955), 317-322.

It is important for citizens to understand science because it is concerned with the means of life.

PIGMAN, Ward. "Science at Bay," CEN, XXXI (February 16, 1953), 652-657.

The importance of rectifying public misunderstanding of science practitioners through using communication to increase the public's understanding and attention to semantics.

RABINOWITCH, Eugene. "Science and Education," *BAS*, XIV (November, 1958), 345.

Editorial introduction to a symposium with this title.

ROSSI, Ennio C. "Why Is the Medical Profession Estimable In the Individual But Not In the Generality?" *PBM*, VIII (Winter, 1965), 230-240.

SINNOTT, Edmund W. "Ten Million Scientists," *Science*, CXI (February 10, 1950), 123-129.

Ways of spreading the scientific spirit through education and the involvement of laymen in scientific research.

STRATTON, Julius A. "Science and the Educated Man," *Phys Today*, IX (April, 1956), 17-20.

The need for education and the place of science in a liberal education.

WEAVER, Warren. "Science and the Citizen," *Science*, CXXVI (December 13, 1957), 1225-1229.

Gives long list of practical problems which require scientific understanding by the ordinary citizen.

________. "Why Is It So Important That Science Be Understood?" *Impact*, XVI (No. 1, 1966), 41-50.

Four aspects of the problem of interpretation of science.

WOLFLE, Dael. "Science and Public Understanding," *Science*, CXXV (February 1, 1957), 179-182.

Assessment of public attitudes shows the need for greater public understanding of science.

7.2 SCIENCE AND TECHNOLOGY IN HIGHER EDUCATION

ADRIAN, Edgar Douglas (Lord ADRIAN). "The Place of Science in Universities Past and Present," *Nature*, CLXXXIII (June 20, 1959), 1706-1709.

"Substance of an address delivered. . .at the Rockefeller Institute. . .", dealing with the place of teaching and of research and with the dangers of state direction.

APPLETON, Edward. "Shortages of Science Applicants to Universities," Nature, CCV (January 16, 1965), 232-233.

The causes of this shortage and their solutions.

BARRY, David G. "Universities as Innovators," Ind Res, VIII (April, 1966), 58-60; 63-65.

Argument for increased involvement by universities in national and regional economic development.

BENNETT, H. Stanley. "The Medical Sciences - A Source of Scholarly Strength for the University," JAMA, CLXXIII (July 30, 1960), 1418-1422.

The historical relationship between universities and medical schools and comments on the present situation.

BOOKER, Henry G. "Academic Organization in Physical Science," Science, CXLVI (October 2, 1964), 35-37.

Universities should organize a unified approach to all pure and applied physical science.

BOWDEN, Bertram Vivian (Lord BOWDEN). "The Lesson of the 'Cow Colleges'," New Sci, XVI (December 6, 1962), 574-575.

The American system of land grant colleges should set an example for the endowment of enduring British colleges and universities.

CALDWELL, Lynton K. "Managing the Scientific Super-Culture: The Task of Educational Preparation," PAR, XXVII (June, 1967), 128-133.

The need for management and administration of our rapidly advancing science and technology as a challenge to universities and government.

CARLSON, Anton J. "The Science Core in Liberal Education," Sci Mon, LXI (November, 1945), 379-381.

Need for science in liberal education and the five essentials of the minimum core of scientific education.

COHEN, Sheldon G. "The Undergraduate Student and Scientific Research at a Liberal Arts College," AIBS Bulletin, VIII (April, 1958), 16-18.

Describes a successful program in experimental biology at Wilkes College.

CONANT, James Bryant. "The Scientific Education of the Layman," Yale Rev, XXXVI (September, 1946), 15-36.

Ways by which colleges may help the public obtain a better understanding of the methods and significance of science.

DUPREE, A. Hunter. "Public Education for Science and Technology," Science, CXXXIV (September 15, 1961), 716-718.

The universities in the U.S. have a duty to make clear the differences between science and the products of technology.

FARRIS, H. W. "The Campus and Industry," Ind Res, VI, No. 4 (April, 1964), 76-81.

Universities assist American industry in consultation, research, and special educational programs, to the benefit of both.

GINZBERG, Eli. "Social Science and the Established Order," Science, CVII (June 11, 1948), 607-611.

Five areas in which the university impinges on social science.

GLASS, Bentley. "Liberal Education in a Scientific Age," BAS, XIV (November, 1958), 346-353.

"Science is. . .the core of a truly liberal education," and the strength of a nation lies in its science.

GRUBER, Howard E. "Science Teachers and the Scientific Attitude: An Appraisal of an Academic Year Institute," Science, CXXXII (August 19, 1960), 467-468.

The successes and failures of a training program for high school sciences and mathematics teachers.

HAWTHORNE, W. R. "M.I.T.: A 20th Century University," New Sci, IX (March 30, 1961), 801-803.

The history and contributions of the Massachusetts Institute of Technology.

HUDSON, F. Lyth and R. H. PETERS. "The Case for University Courses in Technology," New Sci, VII (May 26, 1960), 1339-1340.

Supports a technological rather than a pure science university training for producing technologists.

KILLIAN, James R. Jr. "The University's Responsibility to Science," CEN, XXIX (May 21, 1951), 2033-2035.

The university should always be the haven of the free and individualistic scholar who is uncommitted to any objective but his own.

LAWSON, A. W. "The Role of Scientific Institutes in American Education," Phys Today, IV (September, 1951), 4-5.

The barriers of departmental lines can be overcome in the autonomous institutes for research and instruction.

McNEIL, Elton B. "An International University," BAS, XVIII (October, 1962), 23-24.

The problems to be overcome by and the values to be derived from an international university, particularly in the sciences.

MAHAR, James F. and Dean C. CODDING. "Academic Spinoffs," Ind Res, VII, No. 4 (April, 1965), 62-71.

"Spinoff" businesses, formed by graduate students and professors to capitalize on the results of university research, are economically and socially promising.

MARGENAU, Henry. "Integrative Education in the Sciences," MCMT, XXIV (November-December, 1967), 36-41.

MILLER, James G. "EDUCOM: Interuniversity Communications Council," Science, CLIV (October 28, 1966), 483.

Describes how institutions have joined forces to foster the application of the burgeoning information science to higher education.

RATCLIFFE, J. A. "Science as Part of a General Education," New Sci, II (July 4, 1957), 9-10.

Describes a proposal at Cambridge University to combine principles of science with the arts course.

ROGERS, Eric M. "The Good Name of Science," MCMT, VII (Autumn, 1949), 72-75.

Problems of science course design for general college education. How can we safeguard the good name of science? How can we give the general public a real understanding of science?

SCHEELE, Leonard A. and SEBRELL, W. H. "Medical Research and Medical Education," Science, CXIV (November 16, 1951), 517-521.

Discusses pressure for large scale research and the role of the public health service, and suggests policies for administering grants.

SCHWAB, Joseph J. "The Teaching of Science as Inquiry," BAS, XIV (November, 1958), 374-379.

The case for this new method of teaching science.

SCHWITTER, J. P. "Universities as Research Park Developers," Ind Res, VII, No. 4 (April, 1965), 73-78.

The research park is seen as a way of fostering important and useful interactions between the university and a techno-scientific society.

SPALDING, Keith. "The Relevance of Federal Programs to the Purpose of the Institution," Ed Rec, XLVII (Spring, 1966), 138-147.

The president of a small college urges tailoring contracts and grants to the purpose of the institution and its resources for research.

TALIAFERRO, William H. "Science in the Universities," Science, CVIII (August 13, 1948), 145-148.

Stresses need to support men, not projects, and the need for a greater understanding of the nature of basic research.

TATON, René. "Teaching the History of Science," Impact, IX (No. 3, 1959), 137-149.

Value of a separate department or independent institution for teaching the history and philosophy of science and possible programs.

TAYLOR, Hugh. "Academia and Industry - Their Mutual Influence," Am Sci, LII (December, 1964), 500-512.

The past and present relations between industry and academia, with examples such as catalytic reactions, radio astronomy, and nuclear science.

THIRRING, Hans. "The Step from Knowledge to Wisdom," Am Sci, XLIV (October, 1956), 445-456.

An Austrian physicist argues that the traditional European educational system of narrow training in recognized academic disciplines is insufficient to safeguard our civilization and suggests changes.

TISHLER, Max. "The Debt of Discovery to Learning," PBM, V (Winter, 1962), 244-255.

The impact of government support of research in the lack of support for basic, undirected research and for teaching.

TRACHTMAN, Leon F. "Is Research Interfering with Teaching?" Ind Res, VI, No. 4 (April, 1964), 58-65.

Teaching, and particularly undergraduate teaching at large universities, is being neglected because of emphasis on research.

VAN NORMAN, Richard W. "Undergraduate Training in Experimental Research," AIBS Bulletin, VIII (April, 1958), 18-20.

Describes an experimental course at the University of Utah.

WEISS, Paul. "Science in the University," Daedalus, XCIII (Fall, 1964), 1184-1218.

A moderate view of the impact of science upon the university and an integrated approach to education to offset compartmentalization and isolation.

WILLIAMS, Simon and James D. LAURITS. "Scientists and Education," Sci Mon, LXXII (May, 1951), 282-288.

Authors refute the criticism of the modern American system of education made by Harry J. FULLER in the January, 1951, issue, pp. 32-41.

WINTHROP, Henry. "Needed Reconstruction in Education for a Cybernating Society," Ed Rec, XLVI (Fall, 1965), 400-411.

The necessities for an intellectual education in a "cybernating society" and the need to begin changing higher education at once.

7.3 SCIENCE WRITING AND POPULARIZATION OF SCIENCE

Advancement of Science. "The Dissemination of Scientific Information to the Public," Adv Sci, IV (October, 1946), 19-36.

The British Association in collaboration with the Royal Society recommends establishing an Institute of Scientific Information to be supported partly by private and partly by public funds.

ASHBY, Eric. "Dons or Crooners," Science, CXXXI (April 22, 1960), 1165-1170.

The problems of scientific education for the public.

ASIMOV, Isaac. "View From a Height," CEN, XLIII (May 3, 1965), 90-93.

The future of science depends on effective communication between the scientist and the layman and among scientists themselves.

BAILEY, Herbert S. "The University Presses and the Popularization of Science," Sci Mon, LXIV (May, 1947), 416-420.

The need for popularized books on science and the work of university presses in this field.

BATES, Marston. "The Criticism of Scientific Books," Science, CXV (April 18, 1952), 407-409.

Poor communications between scientists and non-scientists underlines the need for clear writing,and specialized book reviews, based on their intended audience, are needed.

BEHNKE, John A. "Scientific Literacy," AIBS Bulletin, X (April, 1960), 21-22.

An answer to Philip Wylie's article in Vol. IX, June, 1959 (pp. 12-15) about the scientific literacy of biologists and laymen.

BETTS, John Rickards. "P. T. Barnum and the Popularization of Natural History," JHI, XX (June-September, 1959), 353-368.

The popularization of natural history by the curiosity museum and the circus.

BLAKESLEE, Alton L. "Doctors and the Press From a Science Writer's Point of View," JAMA, CLVII (February 12, 1955), 586-588.

BRAGG, Lawrence. "The Art of Talking About Science," Science, CLIV (December 30, 1966), 1613-1616.

Suggestions include presenting members of one branch of science to those in other branches and science presentation to persons of little or no scientific background, such as politicians.

BRAIN, Walter Russell (Lord BRAIN). "Science and Antiscience," Science, CXLVIII (April 9, 1965), 192-198.

Some of the unreasonable suspicions which the non-scientist may harbor about science.

Bulletin of the Atomic Scientists. "American Society of Newspaper Editors Reports on Atomic Information Problems," *BAS,* IV (July, 1949), 211-212; 217.

Problems are training competent reporters; popularizing atomic news; dispelling public fear and ignorance; and guarding national security.

CALDER, Ritchie. "Common Understanding of Science," *Impact,* XIV, No. 3 (1964), 179-195.

Intelligible scientific communication is essential for correct and wise application of scientific discoveries.

________. "Presentation of Science to the Public," *CEN,* XXXII (April 19, 1954), 1590-1593.

How to add color, find the simple similie and the analogy of the commonplace, and other techniques useful in presenting scientific material to the public.

CAREY, Frank. "Reporting Science," *Science,* CXV (April 18, 1952), 409-412.

The training needed for science writers, desirable personal qualities, and the use of language which the public can understand.

COHN, Victor. "Are We Really Telling the People About Science?" *Science,* CXXXXVIII (May 7, 1965), 750-753.

Science reporters are not doing well enough and scientists and science agencies often fail to help.

COLTON, F. Barrows. "Some of My Best Friends are Scientists," *Sci Mon,* LXIX (September, 1949), 156-160.

A science writer discusses his work and makes suggestions for effective science reporting.

DAVIS, Watson. "Science Service and the Dissemination of Science," *AIBS Bulletin,* VIII (November, 1958), 21-23.

The activities of Science Service in reporting science through news releases, publications, and youth programs.

DUBOS, René. "Science and Man's Nature," *Daedalus,* XCIV (Winter, 1965), 223-244.

"Public apprehension and hostility point to the need for an enlargement of science" to make it more relevant to human experience.

FRALEY, Pierre C. and Earl UBELL. "Science Writing: A Growing Profession," *BAS*, XIX (December, 1963), 19-22.

An overview of the profession, its importance to the public, and measures for expanding and improving training for science writers.

FRIENDLY, Alfred. "Scientists Meet the Press," *BAS*, XII (November, 1956), 338-340.

Commends the increasingly close relationship between scientists and the press.

HANDLIN, Oscar. "Science and Technology in Popular Culture," *Daedalus*, XCIV (Winter, 1965), 156-170.

The history of popular attitudes toward science and technology and the growth of a "popular science" to meet the requirements of the population for knowledge which "official" science is too remote to supply.

HILL, John W. and James E. PAYNE. "Scientists *Can* Talk to the Layman," *Science*, CXVII (April 17, 1953), 403-405.

Industrial magazines have contributed fresh insight to the communication problem. Effective stylistic devices to aid the lay reader are suggested.

KILLEFFER, D. H. "Chemistry's Fourth Estate," *CEN*, XXXV (August 26, 1957), 60-62.

Responsibilities and opportunities for chemistry's fourth estate lie in better understanding between scientists and the public.

KRIEGHBAUM, Hillier. "Public Interest in Science News," *Science*, CXXIX (April 24, 1959), 1092-1095.

Public opinion surveys in 1957 and 1958 released by the National Association of Science Writers show a direct relationship between science education and the assimilation of science news.

________. "What's RIGHT With Science News Reporting?" *Science*, CXXIII (April 27, 1956), 707-709.

Report of survey of science news reading habits and a discussion of the adequacy of science news reporting.

LAMING, A. "The Origins of the Popularization of Science," Impact, III, No. 4 (Winter, 1952), 233-257.

The popularization of science, begun in France at the end of the reign of Louis XIV, can be traced in the propagation of the French Revolution and the founding of Western democracies.

LESSING, Lawrence. "Science Journalism: The Coming Age," BAS, XIX (December, 1963), 23.

Popular science writing should be interpretive.

________. "The Three Ages of Science Writing," CEN, XLI (May 6, 1963), 88-92.

Science writing has progressed to the straight news reporting of the computer age.

LYNCH, Russell G. "Linguistic Barriers in Science Writing," BioSci, XVI (November, 1966), 802-804.

The problem of achieving better communication between the layman and the scientist and between scientists.

MARINE, Gene. "Atoms in the Press," BAS, XI (September, 1955), 250-252; 264.

Asks how well the press has fulfilled its responsibility to inform the public fully on matters pertaining to atomic energy.

MEAD, Margaret. "Closing the Gap Between the Scientists and the Others," Daedalus, LXXXVIII (Winter, 1959), 139-146.

Suggests the communication of scientific advances to children as a means of creating a truly scientifically literate society.

METZNER, Charles A. and Julia B. KESSLER. " What Are the People Thinking?" BAS, VII (November, 1951), 341; 352.

Summarizes findings of a survey of public interest in atomic energy.

NELSON, Norman E. "Science and the Irresponsible Imagination," Yale Rev, XLIII (September, 1953), 71-88.

Criticizes "semiscientific popularizers of science who disseminate what they clearly do not understand."

OPPENHEIMER, J. Robert. "The Age of Science: 1900-1950," Sci Am, CLXXXIII (September, 1950), 20-23.

An introduction to 10 science articles addressed to the layman.

PFEIFFER, John. "Making Popular Science More Popular," Science, CXXVII (April 25, 1958), 955-957.

Outlines some methods which, if applied more widely, would popularize science.

________. "Some Comments on Popular-Science Books," Science, CXVII (April 17, 1953), 399-403.

Discusses importance of style and honesty in popular science writing and the usefulness of science history for popular understanding.

RABINOWITCH, Eugene. "Science Popularization in the Atomic Age," Impact, XVII (No. 2, 1967), 107-113.

The new task of science popularization is "to educate mankind for living in the new world created by the scientific revolution."

REUCK, A. V. S., de. "Popularizing Science," Nature, CCIII (July 25, 1964), 340-341.

A meeting of the (British) Scientific Publications Council considers the problems and quality of science popularization.

STRAUSS, Lewis L. "Importance of Science Writing to the Atomic Energy Program," CEN, XXXII (November 22, 1954), 4692-4694.

"Lifts science out of the atmosphere of the cauldron and gives the unspecialized public insight into its workings."

THISTLE, M. W. "Popularizing Science," Science, CXXVII (April 25, 1958), 951-955.

The problem is communication: how to say it correctly, interestingly, and intelligibly.

UBELL, Earl. "Covering the News of Science," Am Sci, XLV (December, 1957), 330A-350A.

A science writer discusses the importance of communicating scientific developments to the public.

WALLIS, F. S. "The Museum As an Aid to Popular Science," Endeavour, V (October, 1946), 149-154.

Museums as a means of interpreting science to the layman and suggestions for their organization.

WYLIE, Philip. "A Layman Looks at Biology," AIBS Bulletin, IX (June, 1959), 12-15.

Specialization among scientists, along with their dislike of amateurs, is building up a barrier for the layman who should have some knowledge and appreciation of science.

SECTION 8

SCIENTIFIC AND TECHNICAL PERSONNEL

Section 8.1 contains materials on the roles of scientists in their professional capacities and in society. Support for scientific and technical activities has often carried with it responsibility for increasing integration of these activities with those of the society in which the scientist functions. Several articles in this section deal with one aspect of this responsibility, the need for some scientists to accept administrative duties. As the scientist functions as part of a wider social environment, there are tendencies to "professionalize" his status and role by, e.g., certification of his professional competency, or explicit delineation of his responsibilities and duties within an organization. Related materials concerning the social roles of scientists will be found in section 12.2. Articles discussing public images of scientists are cited in section 7.1.

Section 8.2 cites articles on the education of scientists and technologists. Although several educational programs are discussed, most of the articles fall under two broad categories: the integration of scientific and technical training with liberal education; and continuing studies to avoid the obsolescence of scientific and technical knowledge. Additional related materials will be found in sections 5.2.1.3, 5.2.1.4.2, 5.2.1.4.3, 5.2.2.2, and 5.2.6.2.

Section 8.3 is concerned with problems of evaluating the quantity and quality of scientific and technical personnel. Much of the material in this section concerns the United States. Manpower studies in other countries will be found in section 5, especially in 5.2.2.4 and 5.2.6.3.

Section 8.4 is directed primarily toward professional organizations in the United States. Related materials will be found in 5.2.2.3 and 5.2.6.1.

Section 8.5 cites articles dealing with such topics as the personality and aptitudes of scientists; scientific creativity; predictive indicators of scientific ability; and the functioning of scientists and engineers in various social environments.

8.1 SCIENTIFIC AND TECHNICAL PROFESSIONALS

BEER, John J. and W. David LEWIS. "Aspects of the Professionalization of Science," Daedalus, XCII (Fall, 1963), 764-784.

The changing social status and role of the scientist and some of the pressures and problems he faces.

BERNARD, Jessie. "Scientists and the Paradox of Power," Soc Forces, XXXI (October, 1952), 14-20.

The traditional role of the scientist is inimicable to the exercise of political power which is today based on the accomplishments of science.

BLACKETT, P. M. S. "Tizard and the Science of War," Nature, CLXXXV (March 5, 1960), 647-653.

The involvement of a British man of science in government over a period of seventeen years.

BOVET, Daniel. "Role of the Scientist in Modern Society--A Symposium: Part I," PBM, VIII (Summer, 1965), 533-545.

Because of his independence of thought, the scientist's main role is to achieve the knowledge which will help liberate mankind from his physical and mental ills.

BRIDGMAN, P. W. "Science and Freedom: Reflections of a Physicist," Isis, XXXVII (July, 1947), 128-131.

Comments on the increasing scale and cost of scientific work and the growing burden of administrative responsibility of the scientist.

BRONK, Detlev W. "The Role of Scientists in the Furtherance of Science," Science, CXIX (February 19, 1954), 223-227.

Men of affairs and social influence should learn more about science and more scientists should become administrators, particularly in higher level government posts.

BUSH, Vannevar. "Professional Collaboration," Science, CXXV (January 11, 1957), 49-54.

The characteristics, privileges, and responsibilities of a profession and the development of collaboration during W. W. II between scientists and military men.

De BELLEFONDS, Josette. "Women and Engineering," Impact, XIV (No. 4, 1964), 249-262.

The suitability of women engineers, the associations functioning for them, and the qualifications they need for this field.

De HEMPTINNE, Y. "The Career of the Research Worker," Impact, VI (September, 1955), 169-180.

The place of the research worker in education, society, and organized research; his professional standing; and the most desirable research climate.

DELAHAY, Paul. "Reflections on the Cultivation of Science," Am Sci, XLVIII (March, 1960), 20-29.

Three aspects of the experience of science are explored.

DRYDEN, Hugh L. "The Scientist in Contemporary Life," Science, CXX (December 24, 1954), 1052-1055.

Discussion of unreasonable demands placed on scientists by American society.

DuBRIDGE, Lee A. "The American Scientist: 1955," Yale Rev., XLV (September, 1955), 1-16.

Suggests that "no area of American life has been so radically changed by world events since 1940 as the world of American science and technology..." and that this has been the result of governmental employment and funding.

DUFFY, John. "The Changing Image of the American Physician," JAMA, CC (April 3, 1967), 30-34.

The physician's status today is higher than it has been during most of the history of the U.S.

FLOREY, Howard (Lord FLOREY). "Development of Modern Science," Nature, CC (November 2, 1963), 397-402.

Why men like the Australian scientist, David RIVETT, now exert a paramount influence on scientific research in all civilized countries.

GIBBONS, Charles C. "The Scientist as Administrator," Res Man, VI (November, 1963), 425-433.

Means of improving the administrative effectiveness of poorly qualified scientists promoted to major supervisory positions.

GLASS, Bentley. "The Academic Scientist, 1940-1960," Science, CXXXII (September 2, 1960), 598-603.

Now heavily supported by federal monies, the academic scientist is beginning to accept political responsibilities.

GRANZEIR, Frank J. "Should Scientists Be Licensed?" Ind Res, VII, No. 10 (September, 1965), 100-103.

Certification by a professional body may serve both to insure the scientist's rights and to upgrade his professional image.

GROSS, Paul M. "The Fifth Estate in the Seventh Decade - The Status of Science and Scientists in the 1960's Reviewed," Science, CXLIII (January 3, 1964), 13-20.

GUINIER, André. "The Spirit of Research in the United States," Phys Today, III (May, 1950), 22-29.

A French scientist's observations on the training and working situations of U.S. scientists.

HASKINS, Caryl P. "Science and the Whole Man," Daedalus, LXXXVI (September, 1956), 113-121.

Trends in science-government relationships and the need to preserve the creative individual in an era of mass organization of science.

HEREIM, Andrew T. "Are Scientists Becoming Administrators?" Am Sci, L (December, 1962), 355A-360A.

The cost of retraining scientists as administrators, the ease of previous training, and the attrition of divided effort.

HOUSSAY, Bernardo Alberto. "Role of the Scientist in Modern Society--A Symposium: Part II," PBM, VIII (Summer, 1965), 546-553.

The significance of science and its social role, and the characteristics, mission, and responsibilities of the scientist.

KELLY, Mervin J. "The Work and Environment of the Physicist: Yesterday, Today, and Tomorrow," Phys Today, X (April, 1957), 26-31.

The past and present situation of physicists and special problems created by society's applications of science.

LAFLEUR, Laurence J. "Cranks and Scientists," Sci Mon, LXXIII (November, 1951). 284-290.

Using VELIKOVSKY as an illustration, LAFLEUR defines a crank and discusses the wisdom or responsibility of the scientist to refute such cranks.

PIEL, Gerard. "Mathematics Comes Out of the Classroom," Yale Rev , XXXIX (September, 1949), 132-141.

Since W. W. II many mathematicians have found prestige, status, and good positions outside the academic life as problem-solvers for government and industry.

POLANYI, Michael. "The Republic of Science: Its Political and Economic Theory," Minerva, I (Autumn, 1962), 54-73.

A comparison of the community of scientists with a free society as a system of "independent self-coordinated initiatives."

ROSS, Sydney. "Scientist: The Story of a Word," Ann Sci, XVIII (June, 1962), 65-85.

The controversial origin of the term "scientist" in connection with the transition of science from an activity of amateurs to a profession.

Scientific Monthly. "The Scientist in American Society," Sci Mon, LXXVIII (March, 1954), 129-141.

Four articles from a symposium given at the 1953 annual meeting of the American Association for the Advancement of Science: Scientists and other Citizens, by Gerard PIEL; Science for Its Own Sake, by Victor F. WEISSKOPF; The Legal Basis for Intellectual Freedom, by Mark De Wolfe HOWE; and Scientists and Political Action, by E. C. KEMBLE.

SILVER, R. S. "The Reality of Engineering," Nature, CXCVII (April 13, 1963), 125-127.

Explores the question of "whether the intellectual activity of engineering has any reality in the pattern of human endeavour."

WAKSMAN, Selman A. "Searchers and Researchers," PBM, VII (Spring, 1964), 309-320.

Remarks on scientists and the variety of their qualifications, activities, and accomplishments.

WARK, I. W. "Scientific Research as a Career," Nature, CXCVII (February 23, 1963), 737-740.

The character and training qualifications needed for a career in scientific research.

WIENER, Norbert. "Intellectual Honesty and the Contemporary Scientist," *ABS,* VIII (November, 1964), 15-18.

Remarks on the organization of science, the proliferation of papers, originality and creativity, and the social uses of science.

8.2 EDUCATION

ALLISON, David. "Educating the Engineer," *IST,* No. 18 (June, 1963), 26-38.

Deals with the shortcomings of engineering education and the need for more and better engineers. Photographs and charts.

BRADLEY, Stanley E. "Medical Education and Medical Research - An Interaction," *NEJM,* CCLXIX (December 12, 1963), 1292-1296.

BRANDWEIN, Paul F. "The Selection and Training of Future Scientists," *Sci Mon,* LXIV (March, 1947), 247-252.

Preliminary work done in training future scientists in the Forest Hills High School, Forest Hills, N. Y., and states the need for a national program to further the best science teaching in high school.

BROWN, Gordon S. "New Horizons in Engineering Education," *Daedalus,* XCI (Spring, 1962), 341-361.

The changing environment of engineering education and appropriate changes in the professional program.

CONANT, James Bryant. "History in the Education of Scientists," *Am Sci,* XLVIII (December, 1960), 528-543.

Argues that scientists may get valuable preparation for such non-science roles as administration and politics by studying the history of science.

De BROGLIE, Louis. "Is Scientific Training Enough for a Man?" *Impact,* I (October-December, 1950), 106-107.

An exclusively scientific education does not allow a man to attain the range of qualities necessary for enlightened leadership. A comprehensive study of man is essential.

ELVEHJEM, Conrad A. "Research and Training," *JAMA,* CLXX (May 23, 1959), 428-432.

Discusses research in medical education. (See other articles on the subject, pp. 432-454 of this issue.)

GREEN, Robert Boyce. "Education in the Sciences," *Sci Mon,* LXXIX (July, 1954), 40-44.

Teaching must aim for an ability to reason and participate and understand rather than a mere acquisition of facts.

GREENEWALT, Crawford H. "The Fickle Fashions of Science," *Am Sci,* XLVI (March, 1958), 46A-48A; 80-83.

Trends in science and the educational system in the light of current needs.

HARNWELL, Gaylord P. "Education and the Generation of New Ideas," *Phys Today,* XV (March, 1962), 34-40.

The features of institutions of higher education which encourage creativity in the sciences.

HAUSER, Ernst A. "The Importance of Science in American Education," *Science,* CXIII (June 8, 1951), 643-646.

Sees American scientific training as too specialized and technical, and stresses the importance of making students understand what science really stands for.

HILDEBRAND, Joel H. "To Tell or Hear Some New Thing," *Am Sci,* LI (March, 1963), 1-11.

"Scientists are best developed in an environment in which science is being pursued as an exciting adventure, where the participants are eager 'to hear, to discover, and to tell some new thing.' "

INGOLD, Christopher. "Education of a Scientist," *Nature,* CXCVI (December 15, 1962), 1030-1034.

Suggestions for school and university education, and the inseparability of teaching and research in the university.

JOHNSTONE, R. Edgeworth. "Some Thoughts on Engineering Education," *Nature,* CXCIII (February 17, 1962), 618-622.

The nature of engineering, its relationship to science, and the necessary attributes of engineering education.

KESTIN, J. "Reflections on the Teaching of Engineering at a University," *Am Sci,* LI (December, 1963), 437-445.

The specific goals of engineering education and comments on quality of instruction, selection of candidates, and teaching methods.

KIRKMAN, A. J. "Turning Scientists into Free Thinkers," *Nature,* CCVI (June 26, 1965), 1293-1295.

The dangers of inflexibility in scientific thinking, and the need for revision of the teaching of sciences to include training in sophisticated thinking.

MESERVE, Walter J. "Man as Scientist," *Am Sci,* XLVII (September, 1959), 222A-232A.

The need for a liberal rather than a specialized education for the scientist.

MEYERS, Russell. "A Critical Look at Medical Education in the United States with Comments on the Role of the 'Specialty Boards,' "*PBM,* I (Autumn, 1957), 48-68.

MILLER, C. Arden. "A Critique of External Forces in Medical Education," *JAMA,* CXCII (June 7, 1965), 145-149.

The influence of examiners and licensing bodies, private foundations, professional societies, and the federal government.

MORRIS, Van Cleve. "Training of a Scientist," *Sci Mon,* LXXXV (September, 1957), 126-129.

Considers reasons for shortage of scientists and blames it not only on educators, but on scientists themselves.

PARK, Ford. "Tomorrow's Engineer," *S+T (IST),* LXXII (December, 1967), 20-34.

The changing tasks and broadening scope of engineering and the type of education that will be required for engineers in the future.

POWERS, Philip N. "The Science Training Group in the Washington Area," *Science,* CIV (November 22, 1946), 477-478.

The importance of opportunities open for professional growth and the need to keep scientists in government and to improve their work.

RABI, I. I. "A Matter of Opinion: Are Scientists Becoming Nothing More than High-Grade Technicians?" Sci Res, II (September, 1967), 62-63.

Criticizes scientists' lack of appreciation of the social relevance of their work and places the blame on the universities.

ROMANO, John. "Comparative Observations of Medical Education," JAMA, CLXXVIII (November 18, 1961), 741-747.

Remarks on U.S. and foreign medical education, stressing the need to keep a balance between research and teaching, and between the laboratory worker and the clinician.

SEIFERT, W. W. "The Prevention and Cure of Obsolescence in Scientific and Technical Personnel," Res Man, VII (March, 1964), 143-154.

Suggests possible ten-week programs of fulltime study for technical personnel for updating technical competence.

SUITS, C. Guy. "Education and Science," Am Sci, XLVII (March, 1959), 60-67.

An essential task of education is to build "a broad base of mutual understanding between all physical scientists and all social scientists."

TAYLOR, James. "Chemistry is Not Enough, or the Increasing Scope of Scientists' Work in Industry," Adv Sci, XVII (September, 1960), 197-206.

The need for scientists to become involved in our technological society and some of the implications for education.

TILSON, Seymour. "Educating the Scientist," S+T (IST), No. 39 (March, 1965), 46-53.

Trends and problems in graduate science education.

TORPEY, William G. "Company Investment in Continuing Education for Scientists and Engineers," Ed Rec, XLV (Fall, 1964), 408-413.

Results of a 1963 survey of company investment in educational activities to update scientists and engineers.

________. "Federal Government Investment in Continuing Education for Engineers," Ed Rec, XLVI (Fall, 1965), 412-415.

Report of survey of 69 federal agencies employing civilian engineers that carried on continuing programs to update engineering education.

VENABLES, P. F. R. "Technical Education in the United States and Great Britain: Some Comparisons," Adv Sci, VIII (December, 1951), 310-318.

The author's observations of several institutions in the U.S. with regard to courses, standards, research staff, and relations to industry.

Von BERTALANFFY, Ludwig. "Philosophy of Science in Scientific Education," Sci Mon, LXXVII (November, 1953), 233-239.

Treats the scope of the philosophy of science and feels that a sound advanced course is essential for the scientist-student to enable him to view science as an integrated whole.

WEISKOTTEN, Herman G. "Lasting Values in Medical Education," JAMA, CLXIV (June 1, 1957), 533-537.

Answers some of the criticisms of medical education and cites progress during the 20th century. (Other articles on medical education, pp. 538-552 of this issue.)

WOODFORD, F. Peter. "Sounder Thinking Through Clearer Writing," Science, CLVI (May 12, 1967), 743-745.

Advocates an appropriately designed graduate course on scientific writing which could strengthen scientific thinking.

8.3 MANPOWER STUDIES

The American Institute of Physics. "The Barton Report," BAS, VI (December, 1950), 355; 375-376.

Recommendations regarding the mobilization of scientific manpower made to the Manpower Office of the National Security Resources Board.

BRODE, Wallace R. "Approaching Ceilings in the Supply of Scientific Manpower," Science, CXLIII (January 24, 1964), 313-324.

Attempts to evaluate potential manpower supply by separating those portions of the population which, by reason of aptitude, sex, ability, or interest, tend to form a professionally-oriented student group.

Bulletin of the Atomic Scientists. "The Thomas Report on Scientific Manpower," *BAS,* VII (March, 1951), 89-93.

Recommendations by the Scientific Manpower Advisory Committee of the National Security Resources Board.

DANILOV, Victor J. "Technical Recruitment," *Ind Res,* V, No. 7 (July-August, 1963), 22-25.

Practices in technical manpower recruitment may contribute to the more than 18 per cent of researchers dissatisfied with their jobs.

DEDIJER, Stevan. "Migration of Scientists: A World-Wide Phenomenon and Problem," *Nature,* CCI (March 7, 1964), 964-967.

The positive aspects of migration and some implications for policy.

———. "Why Did Daedalus Leave?" *Science,* CXXXIII (June 30, 1961), 2047-2052.

The problem of the migration of scientists from underdeveloped countries.

DuBRIDGE, Lee A. "Scientists and Engineers: Quantity plus Quality," *Science,* CXXIV (August 17, 1956), 299-304.

The shortage of U.S. scientists and engineers and the causes and possible solutions.

EIDE, Kjell. "Resources of Scientific and Technical Personnel in the OECD Area," *OECD Observer,* No. 10 (June, 1964), 36-41.

Manpower studies, with breakdown by fields of specialization.

FERDINAND, Theodore N. "On the Obsolescence of Scientists and Engineers," *Am Sci,* LIV (March, 1966), 46-56.

Analyzes the types and causes of obsolescence.

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8.4 PROFESSIONAL ORGANIZATIONS

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The most effective research operation is that which is organized around and oriented towards the creative minds it employs.

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A survey of the individual factors influencing creative sciences and the inherent dangers in political and financial influences on organized research.

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SECTION 9

INTERNATIONAL SCIENTIFIC AND TECHNICAL COOPERATION

Possibilities of international scientific and technical cooperation exist at several levels. National scientific and technical organizations have often formalized and facilitated international communication by forming international unions with their counterparts in other countries. Such unions, and the International Council of Scientific Unions, are discussed in section 9.2.1. International scientific and technical unions often serve as the instruments through which international agreements can be made, e.g., the allocation of radio wavelengths for communication and the reservation of some frequencies for radio astronomy.

Cooperative programs such as the International Geophysical Year have enlisted the scientific capabilities of many nations to further scientific knowledge. International scientific programs may be organized and coordinated by a body which is itself international, such as UNESCO (9.2.2.).

Because of the magnitude and resource requirements of many scientific and technical activities, nations may combine to share the costs of specific projects. Section 9.3.1 deals with Western European experience in such cooperative programs. Utilization, development, and protection of such international resources as international rivers (9.3.6) and the oceans (9.3.7) is often facilitated by cooperative programs.

Section 9.3.2 deals with the role of international technical assistance in social and economic development. Additional related materials will be found in 5.10.

9.1 GENERAL

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McELHENY, Victor K. "Transatlantic Cooperation on Research: New U.S. Moves," *Science,* CLII (April 8, 1966), 190-191.

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Organization for Economic Cooperation and Development. "An Important Sector for Co-Operation in Scientific Research: Water Reserves and Water Pollution," OECD Observer, No. 26 (February, 1967), 38-41.

OECD has had both immediate and long-term approaches to water problems.

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9.3.4 BIOLOGICAL SCIENCE

BioScience. "International Biological Programme: Report of the Planning Committee, November 15, 1963." BioSci, XIV (April, 1964), 43-49.

The complete text of the proposal for the International Biological Programme.

CALDER, Nigel. "World Biology Project Takes Shape," *New Sci*, XXIII (July 30, 1964), 260-262.

Describes the International Biological Programme.

COOLIDGE, Harold J. "Biological Research in the Pacific Area," *AIBS Bulletin*, IV (January, 1954), 19-20.

The work of the Pacific Science Board of the NAS-NRC and of the International Pacific Science Association.

HEDÉN, Carl Göran. "Microbiology in World Affairs," *Impact*, XVII (No. 3, 1967), 187-208.

The critical importance of microbiology to human welfare and the need for more research and cooperative programs such as the UNESCO Micro-organism Program and the International Biological Program.

PANTIN, C.F.A. "The International Zoological Congress: Some Reflections," *New Sci*, IV (July 31, 1958), 535-536.

Reviews a conference held in London.

RABINOWITCH, Victor and Arthur D. HASLER. "The International Biological Program," *BAS*, XXI (October, 1965), 32-34.

The organization, guidelines, purposes, and possibilities for success of the program.

SISSAKIAN, Noräir M. "International Cooperation in the Biological Sciences," *Impact*, XII (No. 3, 1962), 145-156.

International cooperation is vital, particularly in ocean studies, photosynthesis and food production, brain research, public health, and medical science.

STEBBINS, G. Ledyard. "International Horizons in the Life Sciences," *Nature*, CXCVI (November 17, 1962), 611-617.

Surveys present and future international work in biology, including the proposed International Biological Program.

Van PUTTEN, L. M. "Radiobiological Institute of the Organization for Health Research TNO, Holland," Nature, CXCVII (March 23, 1963), 1157-1158.

The facilities, health care of experimental animals, and research programs in somatic radiation effects and their modifications; the prevention and treatment of radiation disease; and the toxic effects of radioactive isotopes.

WADDINGTON, C. H. "Mobilizing the World's Biologists to Enlarge Our Resources," New Sci, XVIII (May 2, 1963), 248-250.

Plans for an International Biological Program to study such topics as human adaptability, conservation, production processes, and marine communities. (See also CALDER, Nigel, "World Biology Project Takes Shape," New Sci, XXIII, July 30, 1964, 260-262, which describes the further development of the program.)

9.3.5 HEALTH

CALDER, Ritchie. "A World Health Research Centre?" New Sci, XXI (January 16, 1964), 146.

Discusses a proposal for a world health research center and urges that a location in England be offered. (See CALDER, Nigel, "The Controversy about World Health Research," New Sci, XXV, January 28, 1965, 207-208, which presents arguments for and against such a center.)

DUNHAM, George C. "Inter-American Cooperation in Medicine," JAMA, CXXVIII (May 19, 1945), 170-173.

The activities of the Institute of Inter-American affairs.

GOLIN, Milton. "World Medicine Comes of Age," JAMA, CLXV (September 7, 1957), 49-52.

The World Medical Association and its work.

HALL, Durward G. "The World Health Organization," JAMA, CLXXXII (October 13, 1962), 168-171.

Report of a U.S. delegate to the 15th World Health Assembly.

MACKENZIE, Melville. "International Collaboration in Health," Int Aff, XXVI (October, 1950), 515-521.

The work of the World Health Organization.

ROSE, Hilary. "The Rejection of the WHO Research Centre: A Case Study of Decision-Making in International Scientific Collaboration," Minerva, V (Spring, 1967), 340-356.

SHARP; Walter R. "The New World Health Organization," AJIL, XLI (July, 1947), 509-530.

SOPER, Fred L. "International Health Organization," JAMA, CLVI (November 20, 1954), 1145-1146.

The complexity of world health organizations and the large role played by the U.S.

TRIMBLE, I. Ridgeway. "Opportunities and Responsibilities of the Physician in World Affairs," JAMA, CLIII (November 28, 1953), 1143-1149.

International cooperation in medicine and the encouragement of personnel exchange programs between hospitals in the U.S. and those abroad.

9.3.6 INTERNATIONAL RIVERS

HIRSCH, Abraham M. "Utilization of International Rivers in the Middle East," AJIL, L (January, 1956), 81-100.

"A study of conventional international law."

LEPAWSKY, Albert. "International Development of River Resources," Int Aff, XLIX (October, 1963), 533-550.

Describes successful international river development projects in Europe, North America, and Asia.

OWENS, W. H. "Putting Mighty Rivers to Work," Courier, XI (August, 1958), 4-7.

Briefly describes river development projects in different parts of the world.

WHITE, Gilbert F. "Rivers of International Concord," Courier, XVII (July-August, 1964), 32-37.

Future river projects will involve several nations in integrated programs of technical and social development.

9.3.7 THE OCEANS

BEHRMAN, Daniel. "Will the Indian Ocean Yield Its Secrets?" Courier, XV (October, 1962), 29-32.

The International Indian Ocean Expedition--a cooperative effort of 20 nations--and its plans to explore every aspect of interest to oceanographers.

CARROZ, J. E. and A. G. ROCHE. " The Proposed International Commission for the Conservation of Atlantic Tunas," AJIL, LXI (July, 1967), 673-702.

Attempts under the Food and Agricultural Organization of the UN "to consider the rational utilization of tuna resources in the Atlantic Ocean."

HUMPHREY, G. F. "The Unknown Indian Ocean: An International Investigation," New Sci, IX (January 5, 1961), 36-38.

The program for oceanographic study of the Indian Ocean.

REVELLE, Roger. "International Cooperation in Marine Sciences," Science, CXXVI (December 27, 1957), 1319-1323.

The need for world-wide cooperation in order to obtain elementary information about the oceans and coastal regions.

SIMON, Noel. "Of Whales and Whaling," Science, CXLIX (August 27, 1965), 943-946.

Politics, economics, science and the International Whaling Commission.

SPILHAUS, Athelstan. "Oceanography: A Wet and Wondrous Journey," BAS, XX (December, 1964), 11-15.

International cooperation in oceanography is necessary and two examples of this are the International Indian Ocean Expedition and the International Cooperative Investigation of the Tropical Atlantic.

STUBBS, Peter. "Fresh Seas and Problems New," New Sci, XXXVI (November 16, 1967), 421-422.

The Intergovernmental Oceanographic Commission of UNESCO plans international studies of the Caribbean and Mediterranean regions.

United Nations Educational, Scientific, and Cultural Organization. "Science and the Sea," Courier, VIII (August, 1955), 12-15.

Various UN bodies are concerned with study of the resources of the sea, and especially of fisheries.

WIMPENNY, R. S. "The International Council for the Exploration of the Sea," Nature, CLXX (November 29, 1952), 906-908.

History and activities of this European organization, founded in 1902.

9.3.8 POLAR REGIONS

BERTRAM, G.C.L. "Antarctic Prespect," Int Aff, XXXIII (April, 1957), 143-153.

The participation of citizens of various nations in the Antarctic and their motives--adventurous, economic, scientific, political and strategic.

BRITTON, Max, ed. "Special Issue on Arctic Biology," BioSci, XIV (May, 1964), 11-51.

Includes 14 articles in the following categories: Introduction; Canadian Arctic Biology; National Agency Programs and Support of Arctic Biology in the United States; Centers of Arctic Biological Research.

CRARY, A. P. "Antarctic Biology: Introduction," BioSci, XV (April, 1965), 251-252.

This introduction is followed by twelve articles on the U.S. Antarctic programs coordinated by the National Science Foundation.

________. "Antarctica--The International Laboratory," BAS, XX (January, 1964), 27-30.

An account of the research programs operating in Antarctica, particularly the American ones and their relationship to international efforts there.

FUCHS, Vivian. "Antarctica: The International Laboratory," Sci Journal, II, No. 11 (November, 1966), 48-54.

Antarctica, as a laboratory and as an arena for international scientific cooperation, has been stimulated by the International Geophysical Year and by the International Years of the Quiet Sun.

HOLDGATE, Martin. "A Decade in Antarctica," Nature, CCXII (October 1, 1966), 12-13.

Reviews the ten-year period of international scientific cooperation in the Antarctic.

PEAVY, Ross C. and Laurence M. GOULD. "Antarctica, International Land of Science," Courier, XV (January, 1962), 9-14.

International cooperation in Antarctic research has culminated in the Antarctic Treaty which ensures that the polar continent will be reserved for peaceful purposes only.

ROBIN, G. de Q. "Future Antarctic Research," New Sci, V (March 5, 1959), 504-505.

The Special Committee on Antarctic Research is an international group set up to review the aims of research in the Antarctic.

WENDT, Gerald. "The Flag of Science on the 6th Continent," Courier, X (September, 1957), 9-15.

International activities in Antarctic during the International Geophysical Year.

SECTION 10

ORGANIZATION AND MANAGEMENT OF RESEARCH AND DEVELOPMENT

Items in this section are concerned with the structure, economics, management, and implications of large scale scientific and technological research. Section 10.1 covers general discussions of private and government-financed research and development.

Section 10.2 is oriented particularly to research and development programs in U.S. Government administrative agencies and research institutions. Some of the articles describe particular programs or institutions. Related items will also be found in Section 5.2.1.4. Other articles cited deal more generally with the place and characteristics of research and development in government.

Section 10.3 refers to industrial research. Among the questions suggested by articles cited here are: How necessary to future growth is a strong industrial research and development program? What is the place of basic research in industry? What are the relationships of industrial research to academic and governmental research?

Section 10.4 deals with research and development in universities. Many of the articles discuss the increasingly complex and interdependent relationships between academic research and governmental missions and programs in the United States. The development of contract research in universities, managerial problems of such research programs, and the impact of contract research on traditional academic goals and values receive particular attention in the literature cited. Additional items will be found under the national or group headings of Section 5. Some of the implications of academic research and development for the education of scientific and technical personnel are discussed in Section 8.2.

Section 10.5 refers to not-for-profit research institutions such as the Rand Corporation. Section 10.6 is concerned with problems of resource allocations for R & D. Such problems are important in industrial as well as in governmental decision-making. Among the topics discussed are the degree of mission specificity which can be imposed on an R & D program; accounting procedures for evaluating optimum returns from support; and--importantly--the side-effects of alternative levels and kinds of support on the development of science, on academic institutions, and on the processes of management or government.

Section 10.7 deals with problems of the administration of R & D programs, including the functions of the administrator and his relations with scientists. Additional items relevant to personnel administration will be found in Sections 8.3 and 8.5. The trend in recent years, particularly in industry, has been towards increasing management of R & D activities and the setting of R & D objectives as an integral part of over-all policy and planning.

10.1 GENERAL

ABELSON, Philip H. "Trends in Scientific Research," Science, CXLIV (January 17, 1964), 218-223.

Attempts to identify the direction in which science is going and the forces that are shaping its future.

BLACKWELL, Gordon W. "Multidisciplinary Team Research," Soc Forces, XXXIII (May, 1955), 367-374.

The distinguishing features of multidisciplinary team research, some of the problems encountered, and ways of minimizing them.

CHAIN, Ernst B. "Academic and Industrial Contributions to Drug Research," Nature, CC (Supplement to Nature of November 2, 1963), 441-451.

Gives examples from the history of drug research which show that the best results have been obtained by close collaboration between academic and industrial laboratories.

Chemical and Engineering News. "Research and Development Feel Government's Impact," CEN, XXXVI (December 29, 1958), 63-69.

The impact of R and D on science and technology and the effects, both good and bad, on industry, the universities, and research organizations.

FRENKIEL, François N. "Basic Research and Defense Developments," Phys Today, XI (July, 1958), 22-24.

The importance of an adequate program of basic research for future technological developments in defense.

GREIG, J. "Science and Engineering," Nature, CCV (March 27, 1965), 1253-1254.

Summarizes an address by O. W. HUMPHREYS in which he discusses the advantages of collaboration by research organizations.

HEIMAN, F. P. "Evaluation of Research from the Viewpoint of the Practicing Scientist," Res Man, VIII (May, 1965), 139-144.

Discussion of corporate policies to ensure top quality research.

HERBERT, George R. "The Surroundings Which Research Requires," Res Man, VI (November, 1963), 401-410.

Analysis of factors which should be examined before the decision is made to develop a new research complex.

HOLTON, Gerald. "Scientific Research and Scholarship: Notes Toward the Design of Proper Scales," Daedalus, XCI (Spring, 1962), 362-399.

The organization and conduct of science which can apply to other fields of scholarship and a qualitative model of the growth process of scientific research.

Impact of Science on Society. "Towards a Synthesis in the Organization of Scientific Research," Impact, XVI (No. 1, 1966), 5-40.

Papers and discussion include: Freedom on Organization in Scientific Research by Pierre AUGER; Lessons the History of Science Teaches by B. KEDROV; Bottle-necks and Interactions between Disciplines by P. PIGANIOL; The Organization of Scientific Work among the Sciences and Its Relations to Technology and Culture, by Gerald HOLTON and Research in the Human Sciences by M. DEBEAUVAIS.

JOHNSTONE, R. Edgeworth. "The Nature of Technological Development," Sci Journal, III, No. 11 (November, 1967), 81-85.

Technological development has requisites for success different from those for pure research, including time-saving techniques in planning and execution and different financing.

KIDD, Charles V. "Basic Research - Description Versus Definition," Science, CXXIX (February 13, 1959), 368-371.

Basic research "has not yet been defined and may never be defined so as to permit an unambiguous, objective measurement of the dollars spent for basic research in this country."

________. "Research Planning and Research Policy," Science, CXVIII (August 7, 1953), 147-152.

The dilemma of research in reconciling the intellectual freedom required for effective exploration of the unknown with the selection and direction of effort implicit in the functions of any organization.

MARSHAK, Robert E. "Basic Research in the University and Industrial Laboratory," Science, CLIV (December 23, 1966), 1521-1524.

The contrasting roles of university and industrial research directors in basic research enterprise.

National Research Council. Committee on Operations Research. "Operations Research: With Special Reference to Nonmilitary Research," Phys Today, IV (September, 1951), 12-16.

The principal features of operations research and how they can be applied to large and complex organizations to increase efficiency.

PLATT, John Rader. "The Step to Man," Am Sci, LIV (September, 1966), 345-358.

Remarks on the organization of scientific research, using the analogy of research as a chain reaction. (Reprint from the book by the same name, (Wiley, 1966), pp. 53-70.)

RAISON, Timothy. "Science, Defence, and the Time Factor," New Sci, III (February 27, 1958), 13-14.

The scientific and political aspects of defense planning and the need to keep up the momentum of research.

REAGAN, Michael D. "Basic and Applied Research: A Meaningful Distinction?" Science, CLV (March 17, 1967), 1383-1386.

The problems arising from the assumption that operational definitions of "basic research" and "applied research" exist.

RUZIC, Neil P. "The Technical Entrepreneur," *Ind Res*, II, No. 2 (April-May, 1960), 10-21.

The characteristics of the traditional entrepreneur--especially risk-taking--should mark the engineer and the technical manager.

SEITZ, Frederick. "A Twenty-Five Year Look into the Future of Research in the Nation--From the Point of View of Government and Academic Research," *Res Man*, VII (January, 1964), 19-26.

Urges increased investment in R & D and predicts a radical change in certain aspects of federal administration of science as growth rate declines.

SIMON, Maj. Gen. Leslie E. "On Bridging the Gap Between Research and Development," *Am Sci*, XL (April, 1952), 323-327.

Argues for the systematic development of new technologies based on new principles in bridging the gap between research and development.

TRUESDELL, Robert W. and Clark A. DUNN. "Research Business vs. Research Institutes," *Ind Res*, I, No. 3 (Summer, 1959), 52-61.

A spokesman for industrial research and a defender of the nonprofit research institute descuss the activities, tax statuses, and responsibilities of the two kinds of operations.

10.2 RESEARCH IN GOVERNMENT INSTITUTIONS

ABELSON, Philip H. "The National Bureau of Standards," *Science*, CLIII (August 26, 1966), 939.

BERKNER, Lloyd V. "The Role of the National Laboratory in American Scientific Progress," *Phys Today*, XI (April, 1958), 18-22.

The close association of national laboratories with universities and the needs they fill in providing expensive research apparatus and climate for group research.

BRIGGS, Lyman J. "Early Work of the National Bureau of Standards," *Sci Mon*, LXXIII (September, 1951), 166-173.

(For the nature and scope of work of the Bureau in 1951, see CONDON, Edward U., "Present Program of the National Bureau of Standards," *ibid.*, LXXIII, September, 1951, 176-182.)

BUECHNER, Helmut K. and F. Raymond FOSBERG. "A Contribution Toward a World Program in Tropical Biology," BioSci, XVII (August, 1967), 532-538.

The Smithsonian Institution's encouragement of international interest in preserving the productivity of tropical environments.

COLBERT, Rear Admiral Leo Otis. "Hitching Our Country to the Stars," Sci Mon, LXV (November, 1947), 372-384.

A brief history of the Coast and Geodetic Survey which charts coastal waters and establishes geodetic control in the interior of the U.S.

CONDON, Edward U. "Some Thoughts on Science in the Federal Government," Phys Today, V (April, 1952), 6-13.

An address given upon Condon's resignation as director of the National Bureau of Standards. Encourages greater government support for non-military science.

DANIELS, Farrington. "The Argonne National Laboratory," BAS, IV (June, 1948), 177-180.

Gives the laboratory's history, organization, and plans for the future.

DuBRIDGE, Lee A. "Science and Government," CEN, XXXI (April 6, 1953), 1384-1390.

Since research laboratories under private management have been most brilliantly productive, the laboratories under military or civil service control should be transferred to private management contracts.

EMBERSON, Richard M. "National Radio Astronomy Observatory," Science, CXXX (November 13, 1959), 1307-1318.

An account of the early history and development of the National Radio Astronomy Observatory at Green Bank, West Virginia.

Environmental Science and Technology. "Big Things Asked for Air Pollution Research," EST, I (December, 1967), 972-975.

Work of the National Center of Air Pollution Control in supporting research.

________. "ESSA, Environmental Innovator and Catalyst," EST, I (January, 1967), 14-16.

The new Environmental Science Services Administration of the Commerce Department.

FLEMMING, Arthur S. "Scientists and the Civil Service," *Sci Mon*, LXIV (June, 1947), 515-520.

The U.S. Civil Service organization for recruitment of scientific personnel, the development of job classification standards, and steps to be taken to attract and hold well-qualified scientists.

GABRIELSON, Ira N. "The Fish and Wildlife Service--A Summary of Recent Work," *Sci Mon*, LXV (September, 1947), 181-198.

Evaluation of progress made in the U.S. Fish and Wildlife Service from 1935 to 1946.

GRAY, Dwight E. "Basic Research in the Office of Naval Research," *Phys Today*, IV (September, 1951), 17-19.

The basic research program of the ONR between the end of W.W. II and the formation of the National Science Foundation.

HARDING, T. Swann. "The Place of Science in Democratic Government," *ASR*, XII (December, 1947), 621-627.

The employment of scientists by the U.S. government and the need for competent administration and adequate technical information.

HORNER, Richard E. "The Government's Problem," *Res Man*, V (September, 1962), 293-308.

Remarks about the development of research within government bodies and in the broader area of government-sponsored research.

LANGER, Elinor. "Chemical and Biological Warfare (1): The Research Program," *Science*, CLV (January 13, 1967), 174-179.

Describes the Detrick research program, University of Pennsylvania, and the involvement of the Public Health Service and various universities and research institutes. (See also *idem.*, "Chemical and Biological Warfare (II): The Weapons and the Policies," *Science*, CLV, January 20, 1967, 299-333, for a discussion of the chemical arsenal, research on incapacitating chemicals, biological possibilities, and U.S. policies.)

LUBKIN, Gloria B. "NBS Moves to Gaithersburg," Phys Today, XIX (November, 1966), 36-42.

The work of the National Bureau of Standards and its new quarters at Gaithersburg, Maryland.

MACY, John W., Jr. "The Scientist in the Federal Service," Science, CXLVIII (April 2, 1965), 51-54.

The increased number of scientists employed by the federal government and the impact this has had on federal personnel policies.

OLD, Bruce S. "The Evolution of the Office of Naval Research," Phys Today, XIV (August, 1961), 30-35.

Background of the Navy's important work in basic science after W.W. II.

PFEIFFER, John E. "The Office of Naval Research," Sci Am, CLXXX (February, 1949), 11-15.

The early work of the ONR gave great support to basic research before the National Science Foundation was established. Table of organization. (See also Luther J. CARTER, "Office of Naval Research: 20 Years Bring Changes," Science, CLXIII, July 22, 1966, 397-400, for a discussion of present personnel, research trends, and budgetary problems.)

Physics Today. "The Astin Case," Phys Today, VI (May, 1953), 20-26.

Description and documents relating to the forced resignation of the director of the National Bureau of Standards, allegedly because of controversy over the worth of a certain battery additive. (HARNWELL, Gaylord P., in "Integrity of Science in Government," ibid., VI, June, 1953, 4, comments on Astin's resignation; ASTIN, Allen V., "The National Bureau of Standards, ibid., VI, June, 1953, 12-13, describes the work and importance of the National Bureau of Standards; "The Kelly Committee . . . A Summary," ibid., VI, December, 1953, 4-11, summarizes the functions and operations of the National Bureau of Standards.)

PIORE, Emanuel R. "Investment in Basic Research," Phys Today, I (November, 1948), 6-9.

The program of the Office of Naval Research to encourage basic research after W.W. II.

PIORE, Emanuel R. "Some Thoughts on Federal Science," Phys Today, VII (July, 1954), 13-15.

Support of basic science by the Office of Naval Research, the dangers of uniformity and centralization of government support, and the responsibilities of scientists to work in areas other than pure research.

PLATT, John Rader. "National Laboratories for Biology?" Science, CXXXVI (June 8, 1962), 859-861.

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REYNOLDS, Orr E. "Support of the Biological Sciences by the Office of Naval Research," AIBS Bulletin, II (April, 1952), 18-20.

RITTERBUSH, Philip C. "Biology and the Smithsonian Institution," BioSci, XVII (January, 1967), 25-35.

The pursuit of broad objectives at the Institution in biological research in systematic biology, photobiology, physical anthropology, conservation, education, and environmental biology.

Scientific Research. "At SRDS: A Meteoric Growth for Science," Sci Res, I (November, 1966), 23-24.

The Standard Reference Data System of the U.S. National Bureau of Standards.

SHALOWITZ, Aaron L. "Nautical Charting (1807-1957)," Sci Mon, LXXXIV (June, 1957), 290-301.

Reasons for coastal charting and the evolution of the Coast Survey in the 150 years since it was incorporated into U.S. law.

SHAPLEY, Willis H. "Special Problems of Military Research and Development," Annals, CCCXXVII (January, 1960), 68-75.

The basic problem of centralized responsibility vs. decentralized management is common to both military and non-military R & D.

SHAW, Byron T. "Research Planning and Control in the United States Department of Agriculture: The Experience of an Old and Well-Established Research Agency," Annals, CCCXXVII (January, 1960), 95-102.

SHELESINYAK, M. C. "Arctic Research Laboratory, Office of Naval Research, Point Barrow, Alaska," Science, CVII (March 19, 1948), 283.

The origins, purposes, and scope of the laboratory.

SHERWIN, Chalmers W. "The New Responsibilities of the Scientific Community Within Government," Res Man, VIII (March, 1965), 95-103.

The need and difficulties in getting capable people for government work as managers of huge research, development, test, and engineering programs. (See also comments by Helmut WAKEHAM, ibid., pp. 105-106.)

TAYLOR, Frank A. "The Background of the Smithsonian's Museum of Engineering and Industries," Science, CIV (August 9, 1946), 130-132.

Capsule history from the Museum's origins in U.S. expeditions, 1838-1842, to a national museum.

WILDHACK, William A. "Standards for the 70's," Ind Res, V, No. 3 (March, 1963), 14-20.

How space age demands are outpacing the existing standards of the exactness of measurements in the National Bureau of Standards.

10.3 INDUSTRIAL RESEARCH

ALLEN, D. H. "Assessing Industrial Research Projects," Sci Journal, I, No. 10 (December, 1965), 79-83.

Criteria and quantitative methods are suggested for dealing with such questions as the funding of research projects, how long development should take, and the termination of unsuccessful research.

BARNES, Carl E. "To Promote Invention," IST, LX (December, 1966), 67-73.

The lack of creativity in industrial research and how farsighted management and revised patent laws might encourage productivity.

BERLAND, Theodore. "Blue Sky Profits," Ind Res, I, No. 3 (Summer, 1959), 44-51.

Analysis of the importance of basic research in industry in terms of dollars and cents.

BOUNDY, R. H. AND L. C. CHAMBERLAIN, Jr. "Problems and Prospects of Industrial Research," *Res Man*, II (Summer, 1959), 81-96.

The probable impact on industrial research of a general profit squeeze and an increasing amount of government-supported research.

CHOLLAR, R. G., G. J. WILSON, and B. K. GREEN. "Creativity Techniques in Action," *Res Man*, I (Spring, 1958), 5-21.

Case history of the development of NCR (No Carbon Required) Paper.

CLARE, J.W.H. "Current Trends in the Organization of Industrial Research," *Res Man*, VI (March, 1963), 135-152.

The basic factors governing industrial research in the U.S., Britain, Germany, and other countries.

COLLIER, Donald W. "The Road Ahead for Profit-Supported Industrial Research," *Res Man*, VII (March, 1964), 129-141.

Predicts continued growth of investment in R & D, but at a smaller rate and with more management integration with corporate policy.

FISHER, J. C. "Basic Research in Industry," *Science*, CXXIX (June 19, 1959), 1653-1657.

The extent of basic industrial research can be measured by the publication of results.

FLECK, Alexander. "Science and Business: A Balanced Partnership," *Adv Sci*, XV (September, 1958), 3-12.

Science needs the resources which business can provide, and in order to provide them, business depends on the products of scientific advance.

FREEMAN, Raoul J. "The Basic Resources of Research," *Res Man*, III (Spring, 1960), 13-25.

Scientific manpower, fundamental scientific knowledge, capital, and their relationship to industrial research are discussed.

FUSFIELD, H.I. "Effect of Government Expenditure on Long-Range Industrial Research," *Res Man*, VII (March, 1964), 107-127.

The three broad effects increasing government expenditures have had from the standpoint of industrial management.

GERSHINOWITZ, Harold. "Industrial Research Programs and Academic Research," Am Sci, XLVI (March, 1958), 24-32.

The programs and methods of industrial research and their effect upon academic research.

GOLDMAN, Irwin. "Government Contract Research and Development: Effect on Planning and Control of Corporate Research Programs," Res Man, VI (January, 1963), 47-62.

The problems of a company which integrates government-sponsored R&D programs with its own programs.

GRAY, John. "Technology and Product Design," Impact, IX (No. 2, 1958), 93-112.

Lessons to be learned from the experience of pioneers and leaders in design.

________. "Technology and the Quest for Materials," Impact, VIII (March, 1957), 32-51.

A study of the problem of materials which urges advance planning for research because the speed at which man augments his resources in the next fifty years will be crucial for social welfare in the 21st century.

HAFSTAD, L. R. "The Role of Industrial Research," Sci Journal, II, No. 9 (September, 1966), 79-84.

Industrial research reduces the time interval between the fundamental principles of an invention and the appearance of a usable product.

HEBB, Malcolm H. and Miles J. MARTIN. "Free Inquiry in Industrial Research," Res Man, I (Spring, 1958), 67-83.

Asks how much freedom is compatible with the aims of industrial research; what criteria should be used in determining the degree of freedom given an industrial researcher; and how the principle of free inquiry can be incorporated into the administration of industrial research.

HERWALD, S. W. "Basic Research in Industry: Status Symbol or Necessity?" Phys Today, XV (January, 1962), 22-25.

A vice-president of Westinghouse Electric Corporation discusses the place of and requirements for basic research in industry.

HOLLAND, Maurice. "Getting Research and Product Development Started in Small Firms," Res Man, II (Winter, 1959), 241-249.

Gives reasons why small firms should engage in R&D and summarizes some major steps in beginning a R&D program.

KASTENS, Merritt L. "Dollars and Science," CEN, XXXII (January 25, 1954), 302-304.

The enthusiasm with which industry has adopted the research technique created a competitive situation and increasing efficiency in research operations is required.

KEYES, Donald B. "Government in Research," CEN, XXVIII (April 3, 1950), 1112-1113.

Chemical development is being stimulated by competition but is not likely to benefit from an overdose of government in research.

KIMBALL, Charles N. "Research and Development Assistance for Small Business Outside of the Company," Res Man, II (Spring, 1959), 13-21.

Describes five ways in which a small businessman can make use of R&D facilities outside his own company.

KNOX, W. T. "Inter-Firm Cooperation in Technical Information," Res Man, VII (September, 1964), 337-348.

Types of inter-firm cooperation in the U.S. petroleum, pharmaceutical, and aerospace industries.

KORNHAUSER, William. "Strains and Accommodations in Industrial Research Organizations in the United States," Minerva, I (Autumn, 1962), 30-42.

Strains and accommodations between science and industry in the formulation of goals for research, modes of control over research, different systems of incentives, and responsibility for the utilization of research.

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The trend is to increasing management of R & D activities, beginning with objectives as an integral part of corporate policy.

SECTION 11

SCIENCE AND CULTURE: HUMANITIES, ETHICS--RELIGION

Science and technology are aspects of human culture and pervasive influences within and upon cultures. In the highly technoscientific cultures in particular, scientific concepts and views of man and nature have had important and demonstrable influences in such areas as literature, the arts, ethics, and religion. The effects of these influences are multi-dimensional. The history of science policy, whether in government or in industry, furnishes examples of conscious attempts to direct the work of scientists and technologists toward goals which are not themselves "scientific" or "technological."

Examples may also be found of non-directive extrascientific influences upon the development and methodology of the sciences. One recent example has been the concern felt by biologists as well as the general public over medical and physiological experiments on human subjects. Here humanistic and ethical restraints have operated to set certain boundaries on what is "permissable" in biological experimentation. Related materials will be found in Sections 2.3, 6, and 12.2.

Many of the items in this section demonstrate influences of science and technology upon esthetic, ethical, and religious perceptions of man and nature. The inclusion of such articles in a bibliography primarily directed to science policy may be justified on the grounds that it directs the attention to a broad perspective of the "fit" of science and technology to the needs and norms of society.

11.1 SCIENCE AND THE HUMANITIES

11.1.1 HUMANISM

ASHBY, Eric. "Humanities for the Technologist," Nature, CLXXX (September 28, 1957), 624-627.

Substance of an address suggesting inclusion of some humanistic studies in higher technological education.

________. "Technological Humanism," Impact, VIII (No. 1, 1958), 45-58.

The essence of technological humanism is the habit of apprehending a technology in its completeness.

ASHMORE, Jerome. "Some Reflections on Science and the Humanities," *Phys Today*, XVI (November, 1963), 46-54.

Essentially, both science and the humanities seek to achieve knowledge and truth.

________. "Technology and the Humanities," *MCMT*, XXII (January-February, 1966), 64-68.

BARBER, Bernard. "Tension and Accommodations Between Science and Humanism," *ABS*, VII (November, 1963), 3-8.

Contrasts those values of science and humanism which make for inevitable tension between them, and insists that a pattern of accommodation must be found so that each is able to fulfill its functions in society.

BROWN, Harcourt. "Science, Humanities, and Artifacts," *Sci Mon*, LXXXIII (October, 1956), 169-175.

The influence of science on humanistic studies, the differences between them, and the fruitfulness of these differences in outlook, methods, and objectives.

CASSIDY, Harold G. "The Muse and the Axiom," *Am Sci*, LI (September, 1963), 315-326.

Portrays the sciences as intellectual activities based on observation of the behavior of nature, the humanities as intellectual activities based on the observations of men in search of themselves, and the two supplementing each other.

________. "The Problem of the Sciences and the Humanities: A Diagnosis and a Prescription," *Am Sci*, XLVIII (September, 1960), 383-398.

Artists and scientists use common intellectual tools of analysis, synthesis, and reduction, and, if they are able to see each other's tools in action, they can understand each other at this level.

CONDON, Thomas J. "Computers, Traditional Research, and the American Council of Learned Societies," *ABS*, X (February, 1967), 4-7.

Some of the first steps taken to provide automated bibliographic services to scholars in the humanities and the social sciences.

DUBOS, René. "Humanistic Biology," Am Sci, LIII (March, 1965), 4-19.

The relationship between biology and the humanities as the study of man's responses to environment.

FARRINGTON, B. "Science and the Classics," Nature, CXCI (September 30, 1961), 1337-1342.

The limitations of science and the importance of humanistic studies.

FELLOWS, Erwin W. "Science and Values: A Survey of Current Points of View," Sci Mon, LXXIII (August, 1951), 111-113.

Briefly views and classifies different theories on the relationship between science and values.

FLECK, Alexander. "Science and the Humanities: Their Basic Unity," New Sci, I (January 24, 1957), 10-12.

The scientist and the humanist have such traits as inquisitiveness, judgment, and imagination in common.

GRAY, James. "The Proper Study of Mankind is Man," Adv Sci, XVI (September, 1959), 3-12.

The study of man's position in the world of nature can help bridge the gap between a scientific and a humanitarian outlook.

HARMAN, Willis W. "The Humanities in an Age of Science," MCMT, XVIII (March-April, 1962), 75-83.

Examines the claims of the humanities to provide a unifying focus for higher education.

HARTNER, Willy. "The Place of Humanism in a Technological World," Tech Cult, III (Fall, 1962), 544-553.

War, aggression, and the arms race are destructive to the interests of humanity and prove that scientific and technical progress do not automatically bring about progress for humanity.

HERRICK, C. Judson. "Scientific Method and Human Values," Am Sci, XXXIV (April, 1946), 239-245.

While social action should be guided by the scientific method, science itself should be guided by human values.

HOAGLAND, Hudson. "Science and the New Humanism," *Science*, CXLIII (January 10, 1964), 111-114.

Science is man's most powerful tool in the use of his unique ability to direct and control his own evolution.

HUXLEY, Julian. "Education and the Humanist Revolution," *Nature*, CXCVII (January 5, 1963), 8-13.

Education in the perspective of evolution, seeking to bring it to terms with humanism over its curriculum, its relations with society, and its methods of fostering the development of personality.

JAKI, Stanley L. "The Role of Faith in Physics," *Zygon*, II (June, 1967), 187-202.

Analogies between scientific and religious faith, and the relevance of the analogy to the split of intellectuals into humanists and scientists.

JOHNSON, Earl S. "Humanism and Science in the Social Sciences," *ABS*, VII (April, 1964), 3-7.

The social sciences as the "middle science" between humanism and science.

JONES, R. V. "Science, Technology and Civilization," *Nature*, CXCIV (June 30, 1962), 1211-1214.

The role of science and technology in ancient civilizations, their contribution to Britain's greatness, and the current need to integrate them with humanistic studies and thought.

LILIENTHAL, David E. "Science and the Spirit of Man," *BAS*, V (April, 1949), 98-100.

Man can use science and technology in the interest of human welfare and the human spirit rather than to destroy himself.

MARGENAU, Henry. "The New Style of Science," *MCMT*, XIX (May-June, 1963), 103-111.

Modern science and its relationship to man's spiritual and cultural concerns.

MATHER, Kirtley F. "The Scientist's Responsibility for the Interpretation of Concepts to Laymen," *MCMT*, X (March, 1954), 81-83.

Scientists must seek concepts that "unite not only the sciences with one another, but also the sciences with the arts and humanities."

MAZLISH, Bruce. "The Fourth Discontinuity," Tech Cult, VIII (January, 1967), 1-15.

The dichotomy between man and the machine must be overcome if we are to be able to live in an industrialized world.

PARR, Albert Eide. "Science, Art and Philosophy," Am Sci, XXXV (January, 1947), 103-106.

The doctrine that science is unconcerned with values is socially dangerous because the exercise of choice within academic freedom implies social values.

PHILIP, Duke of Edinburgh. "Engineers of the Humanities, Science and Technology," Nature, CCVI (May 1, 1965), 439-442.

To achieve value and not be actively harmful, scientific and technological progress must be directed and modified by a social and humanitarian outlook.

RICKOVER, Hyman G. "A Humanistic Technology," ABS, VIII (January, 1965), 3-8.

In order to use technology for the long-term benefit of man and preserve the democratic process, we need professionalization of the decision-making process and basic education for all citizens. (See also idem., "A Humanistic Technology," Nature, CCVIII, November 20, 1965, 721-726.)

ROBERTS, Catherine. "The Modern Biologist and Humanism," PBM, VI (Winter, 1963), 188-202.

Suggests that humanistic ideals be given precedence over biological progress, which is only one facet of human activity.

RUSSELL, Bertrand. "The Divorce of Science and 'Culture'," Courier, XI (February, 1958), 4.

Abridgement of the address given by the recipient of the Kalinga Prize for popularization of science.

SEABORG, Glenn T. "Science and the Humanities: A New Level of Symbiosis," Science, CXLIV (June 5, 1964), 1199-1203.

A culture of new dimensions is emerging from the interaction of the arts and humanities with science, and the contribution of science to archeology and a computerized concordance with the works of St. Thomas AQUINAS.

SIMON, W. M. "The 'Two Cultures' in Nineteenth-Century France: Victor Cousin and Auguste Comte," JHI, XXVI (January-March, 1965), 45-58.

Study of a 19th Century dialogue concerning tensions between "science" and "the humanities."

SINNOTT, Edmund W., "Science and the Whole Man," Am Sci, XXXVI (January, 1945), 127-138.

Qualities held in common by the sciences and the humanities should be emphasized in a liberal education.

WHITEHEAD, T. North. "Humanism in a Scientific Age," Am Sci, XLVI (September, 1958), 309-322.

The study of physical science is not compatible with humanistic studies except for those that have immediate relevance to scientific training.

WILLIAMS, Roger J. "Humanics: A Crucial Need," Sci Mon, LXIV (February, 1947), 174-180.

A call for the study of variability and individuality in human beings for the purpose of helping to solve social problems.

WILSON, J. Tuzo. "Science is Everybody's Business," Am Sci, LII (September, 1964), 266A-276A.

The social effects of the scientific revolution and the need for training humanists in science to better equip them for handling social problems.

11.1.2 LITERATURE

ARNETT, Willard E. "Poetry and Science," JAAC, XIV (June, 1956), 445-452.

Poetry and science satisfy the creative and curious elements of man's nature in much the same way.

BRONOWSKI, Jacob. "The Logic of the Mind," Nature, CCIX (March 19, 1966), 1171-1173.

Science and literature are both seen as acts of imagination limited by the ambiguities of language and operating within the field of self-reference.

GLASS, Bentley. "The Scientist in Contemporary Fiction," Sci Mon, LXXXV (December, 1957), 288-293.

Surveys science as a social force and the personality of the scientist as portrayed in the literature of this century.

GLICKSBERG, Charles I. "Science and the Literary Mind," Sci Mon, LXX (June, 1950), 352-357.

Shows how modern mind has been influenced by the growth of science despite some antagonism from the literary world.

GREENE, D. J. "Smart, Berkeley, the Scientists and Poets," JHI, XIV (June, 1953), 327-352.

A study of the mid-18th century poet Christopher Smart's reaction to Newtonian science.

LARRABEE, Eric. "Science, Poetry and Politics," Science, CXVII (April 17, 1953), 395-399.

The difficulties of public acceptance of science and a sympathetic perspective of the scientists' problems in this area.

McCORQUODALE, Marjorie K. "Poets and Scientists," BAS, XXI (November, 1965), 18-20.

The contradictory models of the world made by poets and scientists, the methods they employ, and the views that result.

MARSAK, Leonard M. "Bernard de Fontenelle: In Defense of Science," JHI, XX (January, 1959), 111-122.

A study of a literary defense of science which linked science securely to the humanities, and accounts for its acceptance in 18th century France.

NICOLSON, Marjorie Hope. "Two Voices: Science and Literature," Am Sci, LI (December, 1963), 454-462.

The "two voices" are a kind of antiphonal chorus--for and against science and all that it implies.

OEHSER, Paul H. "The Lion and the Lamb: An Essay on Science and Poetry," Am Sci, LIII (January, 1955), 89-96.

Science and poetry are two complementary interests of the human spirit which represent different facets of a unitary truth.

PIZER, Donald. "Evolutionary Ideas in Late Nineteenth-Century English and American Literary Criticism," JAAC, XIX (Spring, 1961), 305-310.

RIDGELY, Beverly S. "Dalibray, Le Pailleur, and the 'New Astronomy' in French Seventeenth-Century Poetry," JHI, XVII (January, 1956), 3-27.

A study of the possible stimulation provided to the French literary imagination by the new astronomy of Copernicus, Kepler, and Galileo.

RIVERS, John Peter William. "Technology and Literature," New Sci, XXXV (August 17, 1967), 355-357.

The effect of technology on communication of literature and on its subject matter.

SEEGER, Raymond J. "Scientist and Poet," Am Sci, XLVII (September, 1959), 350-360.

Science and poetry as "partly overlapping spheres in which there is a common domain which ever changes under the changing tension."

TEPPERMAN, Jay. "The Research Scientist in Modern Fiction," PBM, III (Summer, 1960), 547-559.

VIERECK, Peter. "The Poet in the Machine Age," JHI, X (January, 1949), 88-103.

Nineteenth-century poets were among the first to face the moral issue now raised by the atom bomb and the materialistic basis of society.

11.1.3 THE ARTS AND ARCHITECTURE

ALFORD, John. "Problems of a Humanistic Art in a Mechanistic Culture," JAAC, XX (Fall, 1961), 37-47.

AMSTUTZ, G. C. "Symmetry in Nature and Art," MCMT, XXIII (September-October, 1966), 17-21.

ARNHEIM, Rudolf, et al. "Information Theory and the Arts: A Symposium," JAAC, XVII (June, 1959), 501-522.

BALL, Victoria K. "The Aesthetics of Color: A Review of Fifty Years of Experimentation," JAAC, XXIII (Summer, 1965), 441-452.

Aspects of the scientific literature which relate to the subject of how color affects people aesthetically. Footnotes. Bibliography.

BERTOCCI, Peter A. "The Juncture Between Creative Arts and Creative Science," MCMT, XI (January, 1955), 51-54.

The juncture "occurs fundamentally in the life of a human being."

BLACK, Misha. "Art and the Engineer," Nature, CXCI (September 2, 1961), 949-953.

The need for aesthetic considerations in the products of technology and discusses the training and role of the industrial designer.

CANTOR, S. M. "In Art: A Lesson for Chemistry," CEN,XXXIV (November 5, 1956), 5406-5410.

"Chemical education should include courses in art, not to teach the chemist how to paint, but to help him discover more dynamic meanings in his symbols."

CROCKER, Richard L. "Pythagorean Mathematics and Music (Part I)," JAAC, XXII (Winter, 1963), 189-198; Part II, XXII (Spring, 1964), 325-335.

An early attempt to use mathematics to clarify the nature of art.

DOWLING, H. M. "Science and Art," New Sci, XXIV (October 29, 1964), 305-306.

Points out the unifying principle between science and art and the need to apply it in education.

ELSEN, Albert E. "Lively Art from a Dying Profession--The Role of the Modern Artist," JAAC, XVIII (June, 1960), 446-455.

FISHER, Marvin. "Functional Adaptation or Aesthetic Devaluation: Two European Views of Early American Industrial Design," JAAC, XIX (Summer, 1961), 433-437.

FLEMING, William. "The Newer Concepts of Time and Their Relation to the Temporal Arts," JAAC, IV (December, 1945), 101-106.

The customary division of the arts on the basis of space and time should be dropped in favor of adopting the "four-dimensional world of space-time," and viewing all the arts as dynamic.

FRANCASTEL, Pierre. "Technics and Aesthetics," JAAC, XI (March, 1953), 187-197.

Argues for a better understanding of the role of aesthetic values and their relationships with present-day technical values.

FRUTON, Joseph S. "The Arts, the Sciences, and Scholarship," Yale Rev, L (December, 1960), 219-225.

The sciences are much more akin to the creative arts than to the pursuits of humanistic scholars.

GORDON, Donald A. "Experimental Psychology and Modern Painting," JAAC, IX (March, 1951), 227-241.

The three problem areas of modern art which are of interest to the psychologist.

HELM, E. Eugene. "The Vibrating String of the Pythagoreans," Sci Am, CCXVII (December, 1967), 93-103.

The historical relationship between music and mathematics.

HILER, Hilaire. "The Origin and Development of Structural Design," JAAC, XV (September, 1956), 106-116.

A "relatively scientific approach to design or painting" stating that the artist-designer must have some knowledge of contemporary science and philosophy.

HOENICH, P. K. "Robot-Art: The Hopeful Monster," Cybernetica, VI (No. 4, 1963), 179-214; VII (No. 1, 1964), 27-67.

KESSLER, Charles S. "Science and Mysticism in Paul Klee's 'Around the Fish'," JAAC, XVI (September, 1957), 76-83.

Modern theoretical science had a very significant influence on Klee's thinking and imagery.

KUHNS, Richard. "Art and Machine," JAAC, XXV (Spring, 1967), 259-266.

Machines have their place in art museums only if the engineered object has undergone an "artistic remaking."

LAPORTE, Paul M. "Cubism and Science," JAAC, VII (March, 1949), 243-256.

Attempts to explain the new concepts in painting by correlating them with the theories of contemporary physics.

MEYER, Leonard B. "Meaning in Music and Information Theory," JAAC, XV (June, 1957), 412-424.

Parallels between the shaping of musical experience and many details of information theory.

MUNRO, Thomas. "Form and Value in the Arts: A Functional Approach," JAAC, XIII (March, 1955), 316-341.

Possibilities for the development of scientific method in art and aesthetics, and arguments against fears about the "mechanization" of art if scientific knowledge and methods are used.

SANDLE, Douglas. "The Science of Art," Sci Journal, III, No. 3 (March, 1967), 80-85.

The behavioral sciences are providing insights into both traditional problems of philosophical aesthetics and pragmatic concerns with the role of beauty in social life.

SAUNDERS, Frederick A. "Physics and Music," Sci Am, CLXXIX (July, 1948), 32-41.

The physics of music is used in bettering musical instruments, improving building acoustics, and increasing the quality of music reproduction.

SMITH, Michael J. "Science on Canvas," New Sci, XXXV (September 28, 1967), 681-683.

The impact of modern science upon the visual arts.

SOURIAN, Etienne. "A General Methodology for the Scientific Study of Aesthetic Appreciation," JAAC, XIV (September, 1955), 1-18.

The applicability of the quantitative experimental method to aesthetic research.

SPEISER, Andreas. "Symmetry in Science and Art," Daedalus, LXXXIX (Winter, 1960), 191-198.

The relationship between art and mathematics.

TALLMADGE, William H. "The Composer's Machine," JAAC, XIX (Spring, 1961), 339-345.

The role of the performer in the context of his possible replacement by machine.

TAYLOR, Irving A. and Frances PAPERTE. "Current Theory and Research in the Effects of Music on Human Behavior," JAAC, XVII (December, 1958), 251-258.

Von HENNEBERG, Josephine. "The Mutual Influence between Art and Society," MCMT, XXII (September-October, 1965), 17-18.

WALLACH, Michael A. "Art, Science, and Representation: Toward an Experimental Psychology of Aesthetics," JAAC, XVIII (December, 1959), 159-173.

WITTKOWER, Rudolf. "The Changing Concept of Proportion," Daedalus, LXXXIX (Winter, 1960), 199-215.

Describes "the quest for symmetry, balance, and proportional relationships" in the history of art and shows that it exists even in today's technology.

ZUPNICK, Irving L. "Concept of Space and Spatial Organization in Art," JAAC, XVIII (December, 1959), 215-221.

11.2 SCIENCE AND ETHICS

ADAMS, Richard N. "Ethics and the Social Anthropologist in Latin America," ABS, X (June, 1967), 16-21.

The dilemma of identifying the ethics of scholarship as something distinct from the ethics of nationalism.

BARNES, E. W. "Science, Religion, and Moral Judgments," Nature, CLXVI (September 16, 1950), 455-457.

The discoveries of science are leading to new moral and religious problems such as population control, euthanasia, and abortion.

CANNON, Walter F. "The Normative Role of Science in Early Victorian Thought," JHI, XXV (October-December, 1964). 487-502.

For early Victorians, natural science provided the norm by which proposed truths were judged; the alliance between religion and science was shattered by Darwin's evolutionary theory.

CONANT, James Bryant. "Scientific Principles and Moral Conduct," Am Sci, LV (September, 1967), 311-328.

A refutation of the concept that normative ethics can be based on science.

CRANBERG, Lawrence. "Ethical Problems of Scientists--A Summary," Phys Today, XVIII (April, 1965), 51-52.

Lists ten ethical problems associated with science and suggests a study of operating systems of ethical self-regulation. (See also idem., "Ethical Problems of Scientists," Ed Rec, XLVI, Summer, 1965, 282-296.)

________. "Science, Ethics, and Law," Zygon, II (September, 1967), 262-271.

The distinction between science and ethics; attitudes toward social law; and prevalent conceptions of the dichotomy between science and social law.

DINGLE, Herbert. "Science and Ethics," Nature, CLVIII (August 10, 1946), 184-187.

Ethics is not a science because it is not based on the certainties of experience and reason.

FREUND, Paul A. "Ethical Problems in Human Experimentation," NEJM, CCLXXIII (September 23, 1965), 687-692.

FRUTON, Joseph S. "The Aims and Values of the Sciences," Yale Rev, LI (December, 1961), 197-210.

Possibilities and limitations of applying the "answers" of science to human problems; the ethics of scientific investigation; and ethical responsibilities of scientists.

GARBETT, Cyril F. "Science and Ethics," Nature, CLXXII (September 19, 1953), 517-519.

Substance of a sermon delivered before the British Association on moral problems involved in the application of science to human life.

GRÜNBAUM, Adolf. "Science and Man," PBM, V (Summer, 1962), 483-502.

Determinism and indeterminism; applicability of the concepts ot human behavior; and consequences for ethics and morality.

GUTHRIE, R. D. "The Ethical Relationship between Human and Other Organisms," PBM, XI (Autumn, 1967), 52-62.

Legislative action concerning treatment of laboratory animals raises a question as to the role other organisms should occupy in man's ethical system.

HAWKINS, David. "Science and the Ethics of Transition," Phys Today, III (January, 1950), 14-19.

The autonomy of science must move from ethical neutrality to ethical competence and a sense of responsibility for transition.

HILL, A. V. "The Ethical Dilemma of Science," Adv Sci, IX (September, 1952), 93-102.

All citizens are responsible for the right use of the results of scientific research. The scientific spirit and religion or morality need not conflict.

HOAGLAND, Hudson. "Ethology and Ethics--The Biology of Right and Wrong," Zygon, II (March, 1967), 43-58.

A humanistic approach involving 'genetic memory,' adaptive behavior, the physiology of behavior, and the roots of ethics and morals in animal conduct.

Journal of the American Medical Association. "Ethics Governing the Service of Prisoners as Subjects in Medical Experiments," JAMA, CXXXVI (February 14, 1948), 457-458.

Condensed report of a committee appointed by the governor of Illinois.

KELMAN, Herbert C. "Manipulation of Human Behavior: An Ethical Dilemma for the Social Scientist," JSI, XXI (April, 1965), 31-46.

Ethical problems in the study of behavior change and proposed measures to mitigate the dehumanizing aspects by being aware of the manipulative aspects.

KLUCKHOHN, Clyde. "The Scientific Study of Values and Contemporary Civilization," Zygon, I (September, 1966), 230-243.

"Behavioral science may as well resign itself to shallow descriptivism unless it can create the concepts and the methods and techniques required for dealing with statements of value and with non-verbal acts influenced by such abstract standards."

LEYS, Wayne A. R. "The Scientist's Code of Ethics," Phys Today, V (March, 1952), 10-15.

Traditional systems of ethics and their relevance to the choices which a scientist must make in his day-to-day activities.

LONSDALE, Kathleen. "Science and Ethics," Nature, CXCIII (January 20, 1962), 209-214.

The ways in which science influences ethics and the scientists' responsibility to society.

MARGENAU, Henry. "Ethical Science," Sci Mon, LXIX (November, 1949), 290-296.

"The parallelism that exists between the traditional problems of ethics and those of science."

MASLOW, A. H. "Normality, Health, and Values," MCMT, X (March, 1954), 75-81.

"Psychological progress in understanding human nature and a scientific ethics."

MEENAN, Patrick N. "The Human as a Research Subject," Lex et Sci, III (January-March, 1966), 1-7.

Remarks "dealing with why and how we should use human experimental subjects."

MORISON, Robert S. "Darwinism: Foundation for an Ethical System?" Zygon, I (December, 1966), 347-353.

The two contributions made in the field of religious and ethical speculations by Darwin's theory of evolution.

PIGMAN, Ward and Emmett B. CARMICHAEL. "An Ethical Code for Scientists," Science, CXI (June 16, 1950), 643-647.

The tradition of an unwritten code for scientists is seen as outmoded and rethinking is urged, with emphasis on the ethics of scientific publication.

PRICE, Derek J. de Solla. "Ethics of Scientific Publication," Science, CXLIV (May 8, 1964), 655-657.

Some of the issues arising from the "information explosion."

RATNOFF, Oscar D. and Marian F. RATNOFF. "Ethical Responsibilities in Clinical Investigation," PBM, XI (Autumn, 1967), 82-90.

The responsibilities of medical scientists, the public, and government in maintaining ethical standards.

REISSMAN, Leonard and Kalman H. SILVERT. "Ethics and the Third Culture," ABS, X (June, 1967), 1-2.

The "third culture" is that of the social sciences, as opposed to the physical sciences and the humanities.

ROBIN, Eugene D. "Rapid Scientific Advances Bring New Ethical Questions," JAMA, CLXXXIX (August 24, 1964), 624-625.

The need for a new moral code geared to such present problems as the transplantation of organs. (Further discussion in "Clinical Experience Is Tempered by Genuine Human Concern," by John P. MERRILL, 626-627 of this issue.)

ROSEBURY, Theodor. "Medical Ethics and Biological Warfare," PBM, VI (Summer, 1963), 512-523.

Questions the long-term support by physicians of the U.S. program of biological warfare research.

RYLE, John A. "Science and Ethics," Nature, CLVI (November 24, 1945), 619-621.

The atom bomb has demonstrated that scientists can no longer devote themselves only to the pursuit of knowledge, but have the responsibility to see that this knowledge is put to proper use for the benefit of mankind.

SHANBROM, Edward. "Malthus, Morality, and 'Miracle'Drugs," JAMA, CLXXXII (November 24, 1962), 846-857.

The issues raised by use of antibiotics to preserve the life of aged and infirm persons.

SMITH, Vincent E. "Science and the Future," CEN, XXIX (August 13, 1951), 3272-3277.

Discusses: Why do we need thinking beyond science to keep our culture alive and alert? and states that the giant strides in physical science have overrun progress in ethics.

SPERRY, Willard L. "Moral Problems in the Practice of Medicine," NEJM, CCXXXIX (December 23, 1948), 985-990.

A theologian discusses euthanasia and other moral problems that confront doctors.

SYKES, Gresham M. "Feeling Our Way: A Report on a Conference on Ethical Issues in the Social Sciences," ABS, X (June, 1967), 8-11.

Some of the ethical problems confronting the social sciences because of their recent growth.

SZENT-GYORGYI, Albert. "Science, Ethics and Politics," Science, CXXV (February 8, 1957), 225-226.

Argues that the scientist cannot divorce his personal ethical code from his political attitudes and responsibilities.

TAYLOR, Carl E. "Ethics for an International Health Profession," Science, CLIII (August 12, 1966), 716-720.

Raises some of the questions not answered by the physicians' traditional code when involved with world health problems.

THOMAS, Wendell. "Reality and Human Conduct," MCMT, XIX (January-February, 1963), 67-71.

Relevance of modern science to modern morality.

VISSCHER, Maurice B. "Medical Research and Ethics," JAMA, CXCIX (February 27, 1967), 631-636.

The morality of experimentation on animals.

WEAVER, Warren. "Some Moral Problems Posed by Modern Science," Zygon, I (September, 1966), 286-300.

Traditional religious doctrine is often inadequately adjusted to problems posed by science for ethics and theology.

WHIPPLE, Richard O. "The View from Zorna," MCMT, XXIV (September-October, 1967), 3-10.

Discussion of human ecology and scientific ethics. (Continued in ibid., XXIV, November-December, 1967, 42-47.)

WHITLOW, Brian and Fred ROSNER. "Extreme Measures to Prolong Life," JAMA, CCII (October 23, 1967), 374-376.

A theologian and a physician discuss the care of the terminally ill patient.

11.3 SCIENCE AND RELIGION

AUGER, Pierre. "Who? Why? How?" BAS, XI (March, 1955), 74-76.

Asserts the supremacy of the scientific way of observing and handling the world over the older philosophical and religious approaches. (See ibid., NIEBUHR, Reinhold, "Limitations of the Scientific Method: An Answer to Pierre Auger," 87, for a rebuttal of this point of view.)

BAHM, Archie J. "Humanism--A Religion for Scientists," Sci Mon, LXII (April, 1945), 310-335.

Humanism as the religion of those who accept the conclusions of scientific investigations as their beliefs.

BROWN, Sanborn C. "Can Physics Contribute to Theology?" Zygon, I (March, 1966), 14-21.

Theologians should examine the intellectual structure and methodology used by physicists to create their models and try to validate their conclusions.

CAUTHEN, Kenneth. "Science and Theology: From Orthodoxy to Neo-Orthodoxy," Zygon, I (September, 1966), 256-274.

The relationship between science and theology in recent centuries, and a call for a re-construction of current attitudes.

CLARKE, W. Norris. "Technology and Man: A Christian Vision," Tech Cult, III (Fall, 1962), 422-442.

A Christian view of technology and recent papal statements that are relevant.

COULSON, C. A. "Science and Religion," MCMT, XI (May, 1955), 103-107.

The conflicts between science and religion were growing pains as science strove to establish its own place.

FEIGL, Herbert. "Is Science Relevant to Theology?" Zygon, I (June, 1966), 191-199.

Fundamentalist theology is "incompatible both with the most assured results and the most reliable methods of science . . .The much-referred-to religion of great scientists often consists . . . in the belief in the order of nature . . .. Intellectual honesty demands a wholehearted acceptance of a scientifically oriented and philosophically clarified humanism."

GARFINKLE, Norton. "Science and Religion in England, 1790-1800," JHI, XVI (June, 1955), 376-388.

The orthodox opinion that science and religion were complementary, not contradictory, began to break down.

GILL, John C. "Problem: To Establish a Science of Religion," MCMT, XVII (May-June, 1961), 109-113.

"Can the truths of religion be treated as scientific postulates?"

HERRICK, C. Judson. "Science, Faith, and Human Nature," PBM, II (Autumn, 1958), 46-61.

Faith influences all human behavior and faith in the supernatural should not be condemned unless it conflicts with known facts or promotes perverted behavior.

HIEBERT, Erwin N. "The Uses and Abuses of Thermodynamics in Religion," Daedalus, XCV (Fall, 1966), 1046-1080.

A study of "the interaction between thermodynamic thought and religion" during the past century.

KARTMAN, Leo. "Science and the Christmas Spirit," Am Sci, XLVI (December, 1958), 282A-290A.

"What is there in Christ and in religion which is of interest to science?"

LINDSEY, Arthur Ward. "The Faith of Science," Sci Mon, LXVI (May, 1948), 395-398.

A statement of the place of faith in scientific thought contrasted to the faith of popular religion.

MARGENAU, Henry. "Knowledge, Faith and Physics," MCMT, XI (May, 1955), 108-110.

Urges that the criterion of success for theology or physics is the degree of rational coherence.

MELAND, Bernard E. "For the Modern Liberal: Is Theology Possible? Can Science Replace It?" Zygon, II (June, 1967), 166-186.

Views on the relationship of science to religion in the tradition of liberal and 'post-liberal' theology.

ODOM, Herbert H. "The Estrangement of Celestial Mechanics and Religion," JHI, XXVII (October-December, 1966), 533-548.

Historical appraisal of the causes of the split which occurred during the Enlightenment.

OXNAM, G. Bromley. "Religion and Science in Accord," Annals, CCLVI (March, 1948), 141-147.

The common tasks of religion and science--to provide more abundant life and to subject power to moral law.

PRICE, Charles P. "Revealed Religion in an Age of Science," Zygon, II (March, 1967), 23-33.

"Revealed religion, whose theological formulation is open to science, can undergird the scientific enterprise by expressing the source of courage to look and think . . ."

RASMUSSON, H. Richard. "How Far Can Science Reach?" MCMT, XIX (March-April, 1963), 85-89.

"A clergyman questions the ability of science to fulfill all man's needs."

REISER, Oliver L. and Blodwen DAVIES. "Religion and Science in Conflict," Annals, CCLVI (March, 1948), 132-140.

The tendency of organized religion to remain static in a changing world and the postulates of scientific-religious humanism.

RUSSELL, Wallace A. "Beyond Scientism," Zygon, II (June, 1967), 152-165.

A recognition of the functional existence of a basic, science-influenced world view in our society, and an analysis of the implications for orthodox and for liberal religion.

SCHNEIDER, Herbert W. "Evolution and Theology in America," JHI, VI (January, 1945), 3-18.

Four distinguished 19th century philosophical attitudes on the question of evolutionary theory.

TAYLOR, Alfred. "Science and Religion," MCMT, XIX (March-April, 1963), 79-84.

Science and religion are both ways to understanding the truth and both are necessary.

TOWNES, Charles H. "The Convergence of Science and Religion," Zygon, I (September, 1966), 301-311.

"Science and religion are both universal and basically very similar . . .. Understanding the order in the universe and understanding the purpose in the universe are not identical, but they are also not very far apart."

WIEMAN, Henry Nelson. "Science and a New Religious Reformation," Zygon, I (June, 1966), 125-139.

Civilization has reached a new cultural threshold which requires that the resources of science and religion be united if the race is to survive.

WILSON, John B. "Darwin and the Transcendentalists," JHI, XXVI (April-June, 1965), 286-290.

Comments upon reception of Darwin's evolutionary theory by some 19th century American thinkers.

TOPIC 12

SCIENCE AND SOCIETY

Section 12.1 includes items on the place of science in society and on the potentialities of science and technology as instruments for the achievement of social goals. Much of this literature, whether by scientists or non-scientists, reflects a concern for the preservation of humane goals in a technoscientific society. Additional related materials will be found in Sections 4 and 11.1.

Section 12.2 cites articles--for the most part written by scientists themselves--on the ethical and social responsibilities of scientists. Some of the items deal with possible roles of scientists in the political arena. Related materials will be found in Sections 5.2.1.2, 6.5, 7, 11.1.1, and 11.2.

12.1 GENERAL

ADRIAN, E. D. (Lord ADRIAN). "Science and Human Nature," Adv Sci, XI (September, 1954), 121-128.

The need for study of human behavior by the methods of science.

American Association for the Advancement of Science. Committee on Science in the Promotion of Human Welfare. "Science and Human Welfare," Science, CXXXII (July 8, 1950), 68-73.

Indicates the dangers in the current disparity between scientific progress and the resolution of social issues, and suggests specific action by scientists in the promotion of human welfare.

AUGER, Pierre. "Science as a Force for Unity Among Men," BAS, XII (June, 1956), 208-210.

Author believes that the common language of reasoning used in science would be a basis for the unification of man.

AYLLON, T. and Heidi B. HUGHES. "Behavioral Engineering," Sci Journal, I, No. 8 (October, 1965), 69-73.

It is becoming increasingly possible to use the knowledge of how animal and human behavior is initiated and maintained to foster socially desirable behavior.

BERNARD, Jessie. "The Power of Science and the Science of Power," ASR, XIV (October, 1949), 575-584.

The application of science to social life and its inability to make decisions and resolve conflicts of values and goals.

BOHR, Niels. "The Ideal of an Open World," Impact, I (July-September, 1950), 68-76.

Scientific development, which offers great promise for the advancement of human welfare, at the same time threatens it with destruction.

BOULDING, Kenneth E. "Dare We Take the Social Sciences Seriously?" ABS, X (June, 1967), 12-16.

Asks whether we can or should take the social sciences seriously, and answers with a cautious affirmative.

BRAGG, Lawrence. "Science and the Adventure of Living," Adv Sci, VII (December, 1950), 279-284.

The advance of science is bringing in a new era of social existence, a continuation of the change from barbarianism to civilization.

BRIDGMAN, P. W. "Some of the Broader Implications of Science," Phys Today, X (October, 1957), 17-24.

The technological and ideological impact of science on human life.

BURLINGAME, Roger. "Technology: Neglected Clue to Historical Change," Tech Cult, II (Summer, 1961), 219-229.

The impact of technology upon history.

BUSH, Vannevar. "Science and Progress?" Am Sci, XLIII (April, 1955), 241-258.

Bush takes a pragmatic, limited view of progress, arguing that the least science increases knowledge and human comfort, if poperly applied.

CALDER, Ritchie. "Earthlings in the Space Age," Courier, XV (December, 1962), 4-7.

Man's responsibility to use science for the benefit of mankind and the many opportunities available.

CHAMBERS, S. P. "Science and Mankind," *Nature*, CCIII (September 5, 1964), 1010-1013.

An address by the Chairman of Imperial Chemical Industries, Ltd., in which he discusses careers in science and the application of scientific knowledge to human welfare.

CREWE, Albert V. "Science and the War on . . .," *Phys Today*, XX (October, 1967), 25-30.

The urgency for applying science to such problems of society as air pollution, water pollution, and crime.

Daedalus. "Science and the Modern World View," *Daedalus*, LXXXVII (1958).

Nine articles on past, present, and future influence of science upon the world view.

DORR, Harold M., ed. "Social Implications of Modern Science," *Annals*, CCXLIX (January, 1947), (entire issue).

Nineteen articles on five topics: Technology and Society; Political Implications; Science and Social Change; Conjunction of Social and Physical Sciences; and The Problem of Values.

ELLUL, Jacques. "The Technological Order," *Tech Cult*, III (Fall, 1962), 394-421.

The problems posed for men by the technological society and the ethical and spiritual conditions required to resolve them.

FORBES, R. J. "Technology and Society," *Impact*, II (January-March, 1951), 7-9.

The direct and indirect effects of technology on society.

FRIEDMANN, Georges. "The Technocrats and the Technicians' Civilization," *Impact*, II (January-March, 1951).

Civilization is endangered by the technocrats who control techniques such as communications, but who understand neither their impact on man nor "*the high moral purposes* they should serve."

GIFFARD, J.A.H. (Earl of HALSBURY). "Integrating Social with Technological Change," *Impact*, VIII (March, 1957), 3-15.

The social and psychological sciences are our only means for integrating modern man into our technological society.

GOODEVE, Charles. "Science and Social Organization," Nature, CLXXXVIII (October 15, 1960), 180-181.

The application of science to social issues with a study of migration as an example.

HARTLEY, Harold. "Man and Nature," Am Sci, LIII (March, 1965), 127-137.

An address describing man's progress and problems as he learns to understand and manipulate natural processes.

HEILBRONER, Robert L. "Do Machines Make History?" Tech Cult, VIII (July, 1967), 335-345.

A discussion of technological determinism.

HOGG, Quintin McGarel, (Viscount HAILSHAM). "Science and World Affairs," Nature, CXCV (September 29, 1962), 1240-1242.

The need for "an effective world political organization" to contain the threat of nuclear weapons and to marshal the world's resources for aiding underdeveloped countries.

HOLLOMON, J. Herbert. "Modern Engineering and Society: The Marriage Between Technical Ability and Social Needs," CEN, XLII (June 29, 1964), 66-71.

Science and technology are not being used properly to meet the practical needs of our society.

HUXLEY, Julian. "The Future of Man," BAS, XV (December, 1959), 402-404; 409.

The key to man's future lies in science and depends upon his use and understanding of science.

KING, Alexander. "Science and the Changing Face of Industry--The Social Phase," Impact, VII (March, 1956), 3-33.

The nuclear age is the third phase of the industrial revolution and its complexities of discovery and invention have raised social problems which are influencing the development of industry.

Le LIONNAIS, F. "Science and Civilization," Impact, II (July-December, 1951), 84-87.

Man puts his mark on science with his method of discovery; science influences his thought and through technical discoveries the material development of societies.

McHALE, John. "Science, Technology, and Change," *Annals*, CCCLXXIII (September, 1967), 120-140.

"Social accounting" is needed for monitoring and forecasting the effects of science and technology, and would provide a means of evaluating and determining future goals.

MARCUSE, Herbert. "World Without a Logos," *BAS*, XX (January, 1964), 25-26.

The values of science and technology to society, claiming that their techniques perpetuate misery, violence, and destruction.

MUMFORD, Lewis. "Technics and the Nature of Man," *Nature*, CCVIII (December 4, 1965), 923-928.

Contends that the place of technology in man's development has been overemphasized and that is must be subordinated to other facets of human culture if man is to fulfill his basic nature. (See also *idem.*, same title, *Tech Cult*, VII, Summer, 1966, 303-317.)

New Scientist. "1984: Science and Human Goals," *New Sci*, XXI (January 16, 1964), 136-139.

Includes: A British View: Working With What we Know by Lord TODD; An American View: The Scientist in Public Affairs, by I. I. RABI; The Less-Developed World: How Can We Be Optimists? by Abdus SALAM.

PIERCE, J. R. "Technology and Freedom," *New Sci*, XXV (March 11, 1965), 650-651.

The contrasting effects of technology as a collectivizing force and as a means for developing individuality.

POTTER, Van Rensselaer. "Society and Science," *Science*, CXLVI (November 20, 1964), 1018-1022.

Points to need for a new type of scholar, rigorously trained in the humanities and social sciences.

RADER, Melvin. "Technology and Community: The Mandates of Survival," *Sci Mon*, LXVI (June, 1948), 502-513.

Maintains that science and technology can be utilized for the good of man only within a cooperative social order.

ROBERTS, Walter Orr. "Science, a Wellspring of our Discontent," Am Sci, LV (March, 1967), 3-14.

The impact of science on society and the positive aspects of the discontent with the status quo which is characteristic of science and technology.

SCHLESINGER, Arthur M. "An American Historian Looks at Science and Technology," Isis, XXXVI (October, 1946), 162-166.

Urges greater appreciation of the social impact of science and technology.

SEITZ, Frederick. "Science on the March," Phys Today, XV (July, 1962), 24-34.

The role of science in civilization, its present organization and support, and possible future trends in research.

________. "Science and Modern Man," Am Sci, LIV (September, 1966), 227-243.

Man's evolution in biological and social terms, including his development of science and technology with its social and economic impacts.

STOVER, Carl F. "Industry, Technology, and Metropolitan Problems," PAR, XXVII (June, 1967), 112-117.

An experiment in California on the possibility of applying systems techniques to public problems.

THEOBALD, Robert. "Long-Term Prospects and Problems," Tech Cult, III (Fall, 1962), 601-616.

The need for new social systems to cope with technological advance and specific institutions that might be set up for planning and studying the applications of technology.

Von LAUE, Theodore H. "Modern Science and the Old Adam," BAS, XIX (January, 1963), 2-5.

Claims that "science has changed from a philosophic and academic pursuit into a vast social and political effort to manipulate man and nature."

WARNER, John C. "Contributions of Science to the Goal of Civilization," CEN, XXIX (January 8, 1951), 108-110.

"The scientific method, substantially modified, could be used to reach sound solutions to the complicated social, economic, and political problems of the present era."

WATERMAN, Alan T. "The Changing Environment of Science," *Science*, CXLVII (January 1, 1965), 13-18.

Changes include the growing conviction that science is a "savior," but popular misgivings continue and science must maintain its integrity in the face of governmental and industrial demands.

________. "Integration of Science and Society," *ABS*, VI (December, 1962), 3-6.

Points out the dangers of the misuse of science and suggests methods for the constructive use of scientific accomplishments.

WEINBERG, Alvin. "Can Technology Replace Social Engineering?" *Sci Res*, I (July, 1966), 32-33.

Although technological solutions to social problems tend to replace one social problem with another, "the Technological Fix accepts man's intrinsic shortcomings and capitalizes on them for socially useful ends. It is therefore eminently practical and in the short term relatively effective." (See also, *idem.*, same title, in *BAS*, XXII, December, 1966, 4-8, and in *ABS*, X, May, 1967, 7-10.)

WILLIAMS, Robert R. "Natural Science and Social Problems," *Am Sci*, XXXVI (January, 1948), 116-126.

The importance of scientists understanding that "we need nothing physical half so much as we need better understanding of men and of human affairs."

________. "Science and Civilization," *CEN*, XXIX (August 13, 1951), 3268-3272.

Science enlists men unequally in different parts of the world and it does not make the contributions it might to sociological and political ideas.

12.2 SOCIAL RESPONSIBILITIES OF SCIENTISTS

ADAMS, Robert P. "The Social Responsibilities of Science in *Utopia, New Atlantis* and After," *JHI*, X (June, 1949), 374-398.

Compares the utopianism found in these so-called "ideal commonwealths."

ALLISON, Helen C. "Scientist as Citizen," *BAS*, XVIII (May, 1962), 34-35.

The work of Wlater G. WHITMAN, then Science Advisor to the Secretary of State.

American Association for the Advancement of Science. Interim Committee, Ward PIGMAN, Chairman. "Social Aspects of Science," Science, CXXV (January 25, 1957), 143-147.

The impending crisis in the relationships between science and the American society means that the AAAS take immediate action on major social issues of scientific origin.

ASTIN, Allen V. "Scientists and Public Responsibility," Phys Today, X (November, 1957), 23-27.

The primary responsibilities of the scientist to society are to inform and to educate.

BRIMBLE, L. J. F. "Science in the Service of Man," New Sci, III (December 19, 1957), 14-15.

Scientists must communicate with laymen if the discoveries of science are to be used for the benefit of mankind.

BRODINE, Virginia. "Crisis in the Environment: The Scientists' Responsibility," Sci Cit, IX (October, 1967), 188-190.

A report on a conference of the Scientists' Institute for Public Information.

BRONK, Detlev W. "Science and Humanity," Science, CIX (May 13, 1949), 477-482.

The new status of science, considering support for research, the need for more scientists, the spread of science, the social responsibility of the scientist, and the place of basic research.

CALDER, Ritchie. "Science Takes a Look at Itself," New Sci, X (April 27, 1961), 171-173.

The proceedings of international discussions on science and human welfare held at the centennial celebration of the Massachusetts Institute of Technology.

CHERRINGTON, Ernest, Jr. "Science and Society," Sci Mon, LXII (April, 1946), 349-354.

Scientists should make their knowledge and research results available to the layman to improve their relations with society.

CHISHOLM, George Brock. "Social Responsibility," *Science*, CIX (January 14, 1949), 27-30; 43.

Suggests possible contributions from psychiatry and psychology and states that personal responsibility involves the daily improving of local human relations.

COOK, Morris Llewellyn. "Scientists Should Knock at the Door of Politics," *Am Sci*, XXXIV (January, 1946), 87-93.

Participation in community affairs by scientists may give them common ground with politicians and help close the gap between science and politics.

DuBRIDGE, Lee A. "Science and National Policy," *Am Sci*, XXXIV (April, 1946), 226-238.

Explores two tasks of scientists: (1) educating the general citizenry to face problems involving the uses of science; (2) converting expert scientific knowledge into proposals for political action to meet those problems.

DYSON, Freeman J. "Pugwash, 1962," *Phys Today*, XV (November, 1962), 24-26.

Reviews two conferences on science and world affairs.

EINSTEIN, Albert. "On the Moral Obligation of the Scientist," *Impact*, I (October-December, 1950), 104-105.

The international situation would improve if men of science would consider their situation honestly and act in accordance with their findings.

FLOREY, Howard (Lord FLOREY). "Role of the Scientist in Modern Society: The First Three Hundred Years," *PBM*, Spring, 1965), 279-288.

The scientist's role is ". . . to contribute by all means in his power to contemporary culture."

GLASS, Bentley. "The Responsibilities of Biologists," *AIBS Bulletin*, VII (November, 1957), 9-13.

The professional, intellectual, and social responsibilities of biologists.

GODWIN, H. "The Personality of Botany: The Reciprocal Responsibility," *Nature*, CCIV (October 3, 1964), 9-12.

The importance and responsibility of botanists in the life of mankind.

HABERER, Joseph. "Politics and the Community of Science," ABS, X (May, 1967), 10-12; 21-23.

Berates the scientific community in general for a lack of social conscience and cowardice in the face of political pressures.

HASKINS, Caryl P. "Some Challenges of the Future for Sigma XI," Am Sci, LV (December, 1967), 361-374.

An address to the convention of Sigma Xi, describing the current environment of science and its ever-closer connection with social and economic issues.

HAWORTH, Leland J. "Scientists and Society," Phys Today, XVI (July, 1963), 19-22.

The responsibilities of scientists to communicate with laymen, to participate in public service, and to educate the public and the government in the basic facts of science.

HINSHELWOOD, Cyril. "The Scientist and the Future," New Sci, VIII (July 21, 1960), 228-231.

Extracts from a presidential address to the Royal Society of Britain dealing with the relationship of the scientist to society.

HUMPHREY, J. H. "Initiative against Chemical and Biological Warfare," New Sci, XXXI (September 29, 1966), 715-716.

The protest of American scientists against use of chemical and biological weapons in Vietnam, and a Pugwash scheme for international inspection of microbiological laboratories.

HUTCHINSON, Eric. "Science and Responsibility," Am Sci, LII (March, 1964), 40A-46A.

On the nature of science and the ethical problem posed by its public image as contrasted with its actual character.

IHDE, Aaron J. "Responsibility of the Scientist to Society," Sci Mon, LXXVII (November, 1953), 244-249.

In return for the freedom to choose his own field of investigation and make his own decisions on conceptual matters, the scientist is obligated to make his findings public and work for social good.

KARTMAN, Leo. "Science and Atomic Politics," Am Sci, XXXV (July, 1947), 364-370; 376.

Science "has the direct and pressing responsibility of supporting cooperation between the nations of the world in spite of the political and social differences which beset them."

KELMAN, Herbert C. "The Social Consequences of Social Research: A New Social Issue," JSI, XXI (July, 1965), 21-40.

Possible negative features and consequences of social-psychological research, which could be diminished by the commitment of social scientists to an active role in the humanization of society.

KEMBLE, E. C. "Scientists and Political Action, Sci Mon, LXXVIII (March, 1954), 138-141.

"American scientists have a clear duty to keep themselves informed about what is going on, and by individual and collective action to make their voices heard."

KRASNER, Leonard. "The Behavioral Scientist and Social Responsibility: No Place to Hide," JSI, XXI (April, 1965), 9-30.

All the factors which hinder the behavioral scientist from taking a responsible social role are discussed.

LEACH, Gerald. "Science and World Affairs--The Ninth and Tenth Pugwash Conferences," Adv Sci, XIX (November, 1962), 358-360.

History and guiding principles of the Pugwash conferences.

LONG, F. A. "Scientists in Foreign Affairs: Where Do We Go Now?" BAS, XXIII (March, 1967), 14-18.

Past and future contributions of scientists to issues of foreign policy, disarmament, and economic development.

LUNDBERG, George A. "Science, Scientists, and Values," Soc Forces, XXX (May, 1952), 373-379.

The relation of the scientist to social issues and the basic nature of his role as scientist. (See answer by Read BAIN, "The Scientist and His Values," Soc Forces, XXXI, December, 1952, 106-109.)

MACBEATH, A. "A Plea for Heretics," Adv Sci, IX (December, 1952), 262-270.

The heretic or critic who has a scientific attitude toward questioning and testing is indispensable to freedom.

MATHER, Kirtley F. "The Scientist's Responsibility for the Interpretation of Concepts to the Layman," Science, CXIX (March 5, 1954), 299-300.

Scientists need to establish writing concepts between sciences and between science and the arts.

MEEKER, D. Olan. "Doctors and Politics," JAMA, CLXVI (March 15, 1958), 1313-1315.

Historical examples to support the view that doctors should take an active part in political life.

NADER, Claire. "The Technical Expert in a Democracy," BAS, XXII (May, 1966), 28-30.

The nature of the problems raised by the role of the technical expert in a democracy, and the need for developing an ethic of responsibility.

PIEL, Gerard. "The Planet Earth," BAS, XI (September, 1955), 238-243.

The advances of science and its concomitant responsibilities.

________. "Scientists and Other Citizens," Sci Mon, LXXVIII (March, 1954), 129-132.

In the face of ignorant fear the scientist must stand firm on civil liberties, particularly on freedom of the mind.

ROTBLAT, Joseph. "The Pugwash Conferences," New Sci, IV (October 9, 1958), 1015-1018.

The three conferences for consideration of the social, moral, and political implications of science.

RUSSELL, Bertrand. "The Social Responsibilities of Scientists," Science, CXXXI (February 12, 1960), 391-392.

The scientist is a citizen who has a public duty to see that his discoveries are used ethically and serve the public interest.

SACHS, Robert G. "Power of Prediction--An Example," BAS, XX (December, 1964), 20-

A 1945 report of the author points to "the power of prediction that is in the hands of the scientist."

SALAM, Abdus. "Philosophers as Kings," New Sci, XVII (March 7, 1963), 515-516.

The responsibilities of scientists for the problem of world developments.

SANFORD, Nevitt. "Social Science and Social Reform," JSI, XXI (April, 1965), 54-70.

The relationship between science and value, value positions for social scientists, and the role of the social scientist in society, especially with regard to research on large organizations.

SCHENKEN, J. R. "The Scientist as a Citizen," Science, CXXI (February 11, 1955), 184-186.

The delicate relationship between science and politics requires a mature and intelligent response from the scientist.

SCHWARTZ, Leonard E. "Perspective on Pugwash," Int Aff, XLIII (July, 1967), 498-515.

The history and accomplishments of the Pugwash Conferences on Science and World Affairs.

SEABORG, Glenn T. "Scientists Shed Wicked Wizard Tag," CEN, XLII (December 21, 1964), 60-62.

Both scientists and non-scientists now consider the social consequences of scientific ventures.

STAKMAN, E. C. "Science and Human Affairs," Science, CXIII (February 9, 1951), 137-140.

The role of the scientist as citizen and the charge that science "dehumanized" knowledge.

STEVENS, Neil E. "The Moral Obligation To Be Intelligible," Sci Mon, LXX (February, 1950), 111-115.

The scientist has a moral duty to make known to the layman as much of his work as possible, and to do so, he must write simply.

United Nations Educational, Scientific, and Cultural Organization. "Pugwash," *Courier*, XVII (November, 1964), 20-21.

The Pugwash Conferences, "a movement among scientists seeking an international exchange of ideas on the impact of science on human affairs."

WIRTH, Louis. "Responsibility of Social Science," *Annals*, CCXLIX (January, 1947), 143-151.

The impact of science upon society presents a challenge to the social sciences to learn more about "power relations among men and the means for generating the will and the capacity for action directed toward the achievement of a good society."

ZHMUDSKY, A. Z. "The Scientist's Responsibility Towards Society," *Impact*, XIII (No. 4, 1963), 301-310.

It is still the responsibility of the scientist to conduct his research so as to serve the welfare of humanity.

GUIDE TO INDEX

In the interests of brevity and for efficient use of the bibliography, the following index devices have been employed. The user should become familiar with these, and especially with the abbreviations of the fifty journals covered in the bibliography and listed at the end of this guide. In general, articles are indexed only under the authors' names. The detailed classification of the items indicated in the table of contents serves as a subject index.

(1) Year of publication.
Because the bibliography covers material published from the beginning of 1945 to the end of 1967 only, the first two digits of the year have been omitted. Therefore "65" appearing immediately after the journal name indicates that the article was published in 1965.

(2) Cross-indexing.
(a) With very few exceptions where the article was indispensable to more than one classified topic, there has been no cross-indexing of subject matter, each article appearing in the bibliography only once. Thus the figure "298" immediately following the two digits of the year of publication indicates the page on which the article is described.
(b) Articles by two or more authors are indexed under each author, but in different form. When indexed under the first, or primary author--the form in which the article was published--the item will appear as "PARKS, Larry G. and Stuart S. DYE." When indexed under the second, or subsequent authors, the form used is "DYE, Stuart S. (PARKS, Larry G. and Stuart S. DYE)." Thus such a parenthesis always indicates that the index item is being listed under a secondary or subsequent author's name. In this way a user who may not know the name of the primary author is certain to find the article, and he will also find it easily when consulting the journal.

(3) Identification of authors.
The names of authors do not always appear in the same form in all of their publications. Sometimes initials are substituted for given names; names may also be given fully or only in part. Pseudonyms are occasionally used. So far as possible, all items by the same author have been listed under a single author entry. But if it could not be established that authors with similar names or initials were the same individuals, separate listings have been provided.

(4) *Titled English authors.*

Because many of the journals are either published in Great Britain or follow English usage, the following adaptations have been made between English and American usage in regard to titled authors.

- (a) The title of "Sir" has been omitted entirely.
- (b) If the title is the same as that of the author's family name, it appears after the name in parentheses. An example is "SNOW, C. P. (Lord SNOW)."
- (c) If the author's title is different from his family name, the author is indexed under his family name with the title following in parentheses. Thus, the form is; "HOGG, Quintin McGarel (Lord HAILSHAM)." However, since titled authors are often published in Britain *only* under their titles, in such cases "HAILSHAM, Lord," is included *in* the index with the reader directed to look for the article under "HOGG."
- (d) Articles by Prince Philip, the husband of Queen Elizabeth II, are indexed under "PHILIP, Duke of Edinburgh," which is customary usage.

(5) *Grouped articles.*

In a number of instances articles by the same author pertaining to the same subject are grouped together in the annotation, especially if they appeared in the same journal. The editors not infrequently encountered substantially identical articles by the same (often prestigious) authors under different titles in different journals. Nothing would be gained by separate annotation of these essentially identical articles. Less frequent groupings include articles by different authors who hold opposite points of view of the same subject; short articles pertinent to the subject matter of the indexed article; and articles which are replies to an exchange of letters. Such items mentioned in the annotation are indexed under the author's name. These groupings were made to conserve space and to direct the user's attention to immediately useful material on the subject.

(6) *Entire issues of journals.*

A number of "entire issues" of journals are included in the bibliography, and frequently the individual contributors and the titles of their articles are mentioned in the annotation. An example of this is "ABELSON, Philip et al. "Science in the U.S.S.R.," *Science*, CXXVI, (November 29, 1957). In such cases these contributors are *not* indexed separately because either the entire issue pertains to the subject, as in the case above, or it was considered sufficient to index such articles under the name of the editor of the issue.

(7) Journal abbreviations.

Most of the abbreviations in the following list are those used in standard library procedure; in a few cases of lesser known journals, such as nos. 25 and 32, the editors simply chose abbreviations which not only seemed appropriate, but would distinguish them from the abbreviations of journals having similar titles. Single-word journal names were not abbreviated. Quick memorization of the abbreviations will greatly expedite the use of the bibliography.

	Titles	Abbreviations
1.	Advancement of Science	Adv Sci
2.	American Behavioral Scientist	ABS
3.	American Political Science Review	APSR
4.	American Scientist	Am Sci
5.	American Journal of International Law	AJIL
6.	American Sciological Review	ASR
7.	Annals of Science	Ann Sci
8.	Annals of the American Academy of Political and Social Science	Annals
9,	AIBS Bulletin (Bio Science)	AIBS Bulletin (BioSci)
10.	Bulletin of the Atomic Scientists	BAS
11.	Canadian Scientist	Can Sci
12.	Chemical and Engineering News	CEN
13.	Cybernetica	Same
14.	Daedalus	Same

	Titles	Abbreviations
15.	Educational Record	Ed Rec
16.	Endeavour	Same
17.	Environmental Science and Technology	EST
18.	Impact of Science and Technology	Impact
19.	Industrial Research	Ind Res
20.	International Affairs	Int Aff
21.	International Science and Technology	IST (also S & T (IST))
22.	Isis	Same
23.	Journal of the American Medical Association	JAMMA
24.	Journal of Aesthetics and Art Criticism	JAAC
25.	Journal of the Australian Regional Groups, (etc)	Pub Ad Aus
26.	Journal of the History of Ideas	JHI
27.	Journal of Social Issues	JSI
28.	Nature	Same
29.	New England Journal of Medicine	NEJM
30.	New Scientist	New Sci
31.	Lex et Scientia	Lex et Sci
32.	Main Currents in Modern Thought	MCMT
33.	Minerva	Same

	Titles	Abbreviations
34.	OECD Observer	Same
35.	Perspectives in Biology and Medicine	PBM
36.	Physics Today	Phys Today
37.	Political Quarterly	Pol Q
38.	Public Administration Review	PAR
39.	Research Management	Res Man
40.	Science	Same
41.	Science Journal	Sci Journal
42.	Scientific American	Sci Am
43.	Scientific Monthly	Sci Mon
44.	Scientist and Citizen	Sci Cit
45.	Scientific Research	Sci Res
46.	Social Forces	Soc Forces
47.	Technology and Culture	Tech Cult
48.	UNESCO Courier	Courier
49.	The Yale Review	Yale Rev
50.	Zygon	Same

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